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Water use efficiency for corn among the Spanish irrigation associations from the Spanish Duero basin

Daniel Alberto Segovia Cardozo, Sergio Zubelzu , and Leonor Rodriguez-Sinobas

Research Group "Hydraulic for Irrigation"UNIVERSIDAD POLITÉCNICA DE MADRID, ESCUELA TÉCNICA SUPERIOR DE INGENIEROS AGRÓNOMOS, INGENIERÍA AGROFORESTAL, MADRID, Spain (leonor.rodriguez.sinobas@upm.es)

Agriculture is the highest user for world water consumption. Considering the present and future water scarcity scenario, the irrigated agriculture would be affected by the reduction on water supply thus, would increase the competition among users. Moreover, these facts could have a negative impact on the National gross income. Thus, a proper planning on water allocation, and its management among users, will be key issues to decrease any pressure over water resources.
Spain is a semiarid country where the 75% of the water consumption goes to irrigation systems . In the future, this value will have to decrease to adapting to climate change.
This work addresses the estimation and comparison of water use efficiency among the irrigation associations in the Duero basin. Likewise, the work assesses if the water allocated to irrigation districts for the basin Authorities is adequate to fulfil the water requirements for the major crop in the basin (corn).
First, the average crop coefficient Kc values for corn for six Irrigation districts (CCRRs) associations, and their municipalities, was obtained by satellital images (Landsat 8, Sentinel 2A and 2B) for the different phenology stages during the period 2014-2017. Then, for each municipality in every irrigation district, the Kc values were fitted to a theoretical Kc curve (R2 [U+F0B3] 0.97) and water requirements were calculated following the FAO procedure. The Penman-Monteith equation was used to estimate the reference evapotranspiration and the real evapotranspiration with the climate information logged in the nearest weather stations.
The net irrigation supply was calculated next and finally the gross irrigation supply by dividing the first for the irrigation efficiency in the area (85%).
The water use efficiency was determined by the following indicators: annual relative water supply (ARWS) and the annual relative irrigation water supply (ARIS) and relative precipitation supply (RRS).
Variability in the crop coefficients for each year was small among municipalities in the irrigation associations. However, the differences among years for each municipality were larger depending on the time of sowing. The mean crop coefficients during the study period for all the irrigations districts were: Kcini = 0.4, Kcav = 1.08 and Kcfin = 0.55. These values are closed to the ones recommended by the Irrigators Advisory Board ITACyL in the on-line platform INFORIEGO (www.inforiego.org) which were obtained from FAO databases.
Values for the ARIS indicator show a good irrigation management for 2014, slightly over-irrigation for 2015 and clearly over-irrigation for 2017. However, they show deficit irrigation for 2016. This could be due to the low water storage in the dam.
Values for ARWS indicator show an excess of water application in some of the CCRRS for 2014, 2015 and 2017. In general, the water supply by precipitation (RSS) only cover the 10% off the crop requirements.
The methodology presented in this work could assist water stakeholder decisions for water management strategies at the irrigation district.Moreover, the results could be references for benchmarking at regional, national or international level.