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How to expand irrigated land in a sustainable way ?

Amandine V. Pastor (1), Fulco Ludwig (1), Amanda Palazzo (2), Petr Havlik (2), Pavel Kabat (1,2)

(1) Wageningen University, Earth system sciences and climate change, Wageningen, Netherlands (amandine.pastor@wur.nl), (2) International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria

Allocation of agriculture commodities and water resources is subject to changes due to climate change, population increase and changes in dietary patterns. This study focused on including global water availability including environmental flow requirements with water withdrawal from irrigation and other sectors (industry, household and hydropower) at a monthly time-step in the GLOBIOM model. This model allows re-adjustment of land-use allocation, crop management, consumption and international trade. The GLOBIOM model induces an endogenous change in water price depending on water supply and demand. In this study, the focus was on how the inclusion of water resources affects land-use and, in particular, how global change will influence repartition of irrigated and rainfed lands at global scale. We used the climate change scenario including a radiative forcing of 2.6 W/m2 (RCP2.6), the socio-economic scenario (SSP2: middle-of-road), and the environmental flow method based on monthly flow allocation (the Variable Monthly Flow method) with high and low restrictions. Irrigation withdrawals were adjusted to a monthly time-step to account for biophysical water limitations at finer time resolution. Our results show that irrigated land might decrease up to 37% on average depending on the choice of EFR restrictions. Several areas were identified as future hot-spots of water stress such as the Mediterranean and Middle-East regions and parts of South-East Asia where the Water Stress Indicator (WSI) ranges from 0.4 to 1 by 2050. Other countries were identified to be in safe position in terms of water stress such as North-European countries. Some countries such as India expect a significant increase in water demand which might be compensated by an increase in water supply with climate change scenario. Re-allocation of rainfed and irrigated land might be useful information for land-use planners and water managers at an international level to decide on appropriate legislations on climate change mitigation/adaptation when exposure and sensitivity to climate change is high and/or on adaptation measures to face increasing water demand. For example, some countries are likely to adopt measures to increase their water use efficiencies (irrigation system, soil and water conservation practices) to face water shortages, while others might consider improving their trade policy to avoid food shortage.