Author(s) + Affiliation (s)

Amanda Palazzo 1; J.Arbelaez-Gaviria 1,2; E. Boere 1; D Leclere 1; S. Frank 1; C. Janssens 1,3; P. Havlík 1; T. Kahil 1; J. Balkovič 1; P. Burek 1
1 IIASA 2 Mendel University of Brno, CzechGlobe 3 University of Leuven (KU Leuven)

FORUM ON SCENARIOS FOR CLIMATE AND SOCIETAL FUTURES

Laxenburg, Austria June 20-22, 2022

Session ID no. 22

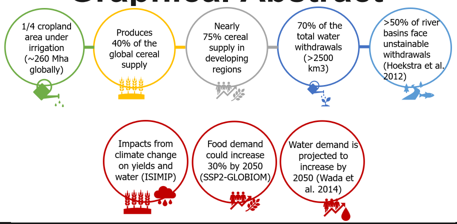
An integrated assessment of agricultural hotspots and irrigation as a climate adaptation option

Author contact details

Email: palazzo@iiasa.ac.at

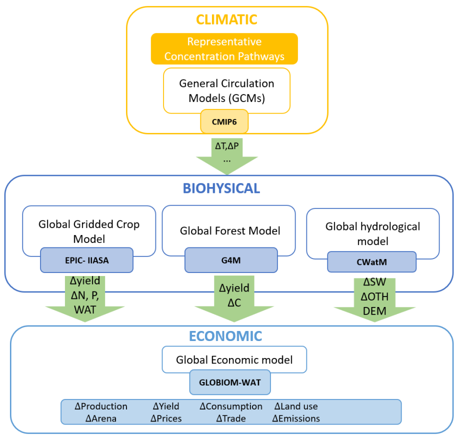
Twitter: @AmandaMPalazzo

Graphical Abstract



Methods

We assess the impact of climate change and potential agriculture hotspots through the systematic integration of three types of models: climate, biophysical and economic, to inform the response of irrigation expansion as adaptation strategy.
We use the most recent drivers of global change: the CMIP6 climate change projections from five global climate models (GCMs) to 2100 and the combined representative concentration pathways (RCPs) and shared socioeconomic scenarios (SSPs) (SSP_RCP).
Crop productivity and input requirements and the availability of water for irrigation are integrated into the economic land use model Global Biosphere Management Model (GLOBIOM) to assess the relative changes in production, consumption and market conditions.



Figures

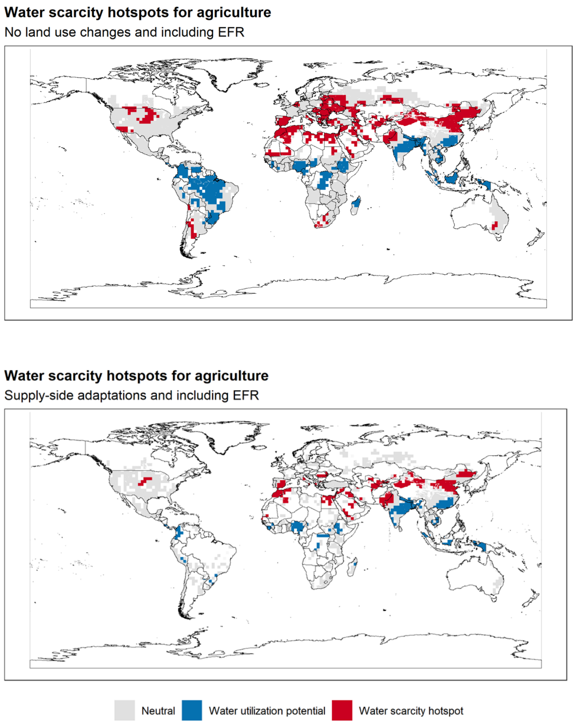


Figure 1. Water Scarcity hotspots, calculated using local indicators of spatial association (LISA) based on an indicator of water balance using aggregated runoff, water demand from other sectors, change in irrigation crop water requirements and environmental flow protections (a) with no land use adaptation options considered (b) with adaptation options considered represented by the GLOBIOM economic land use model

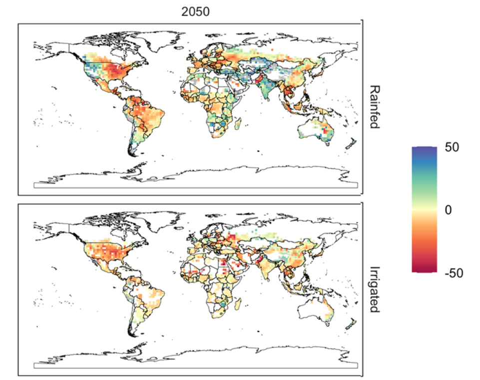


Figure 2. Percent change in yield for RCP 7.0 with CO2 eff. and UKESM1-0-LL for a crop aggregation in 2050

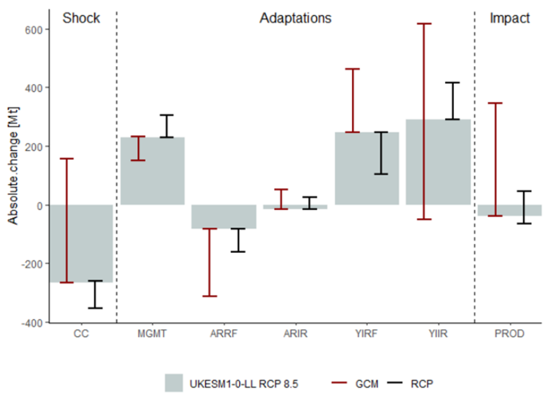


Figure 3. Disaggregation of adaptation options to CC in 2050
CC: Total loss in production due to climate change shock
MNGT: Total change in production due to other management changes .
ARRF and **ARIR**: Adaptation through additional area allocated to rainfed (ARRF) and irrigated (ARIR) systems.
PROD: Total production change including adaptation, can be split between irrigated (YIIR) and rainfed (YIRF) systems.

Conclusion

1)The impact of climate change on global crop production (with CO2 fert. effects) are split, with some GCMs showing positive overall impacts and others showing negative impacts (Fig 2 and 3).

2)Changes in management (crop reallocation within available land, management change within rainfed systems, change from rainfed to irrigated systems on available cropland) help to offset the impacts from climate change (Fig3).

3)Irrigation may be an effective strategy for climate change adaptation but impacts are crop and location dependent and the spatial and temporal availability of water for irrigation are important and may limit potential (Fig 1 and Fig 3)

4) Allowing for supply side adaptations (e.g. land use change and international trade) reduce the number of water scarcity hotspots (Fig 1)

5)Economic suitability for irrigation, which considers virtual water flows, water supply and system costs, needs to be considered in addition to water availability.

6)Sustainable local water storage may be an economical solution for irrigated areas to mitigate intra-annual variability and unlock adaptation potential.

NAVIGATE

Funding for this work comes from the NAVIGATE project funded from the European Union's H2020 research framework programme under Grant Agreement No 821124

Keywords:

Impacts, Adaptation, Socioeconomic change