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Global opportunities in land and water use while staying within the safe (and just) operating space: quantifications of interactions and tradeoffs

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Staying within the safe and just operating space as defined by multiple planetary boundaries will be a major challenge especially in view of anticipated future increases in food demand, the potential need for balancing climate change (e.g. through terrestrial carbon dioxide removal) and its impacts, and the water and land demand associated with these goals and measures.
This presentation will show simulation results from a comprehensive model-based study on the global potentials of diverse crop management options considered as opportunities to stay within the planetary boundaries for human freshwater use and land-system change. The quantified on-farm options include rainwater harvesting, soil conservation and more efficient irrigation, all of which are designed to use neither more water nor more land for agriculture than is presently the case.
Results show that irrigation efficiency improvements could save substantial amounts of water in many river basins (globally 48% of non-productive water consumption in an ambitious scenario), and if rerouted to irrigate neighbouring rainfed systems, could at the same time boost kilocalorie production by 26% globally. Low-tech solutions for small-scale farmers on water-limited croplands show the potential to increase rainfed yields to a similar extent. In combination, such ambitious yet achievable integrated water management strategies could increase global kcal production by 41% and close the water-related yield gap by 62%. Global climate change would have adverse effects on crop yields in many regions, but the improvements in water management quantified here could buffer such effects to a significant degree. Thus, a substantial amount of anticipated future needs for food production could be fulfilled without further approaching / transgressing planetary boundaries.
In addition, it will be shown how large-scale biomass plantations for the purpose of terrestrial CO_2 removal (climate engineering, potentially implemented should the planetary boundary for climate change be further transgressed) would impact on land and water resources and, thus, how such measures would compromise attempts to stay within the safe operating space. In conclusion, this presentation provides new quantitative evidence for significant interactions and tradeoffs among different planetary boundaries.