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Water savings of redistributing global crop production

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Human demand for crop production is expected to increase substantially in the coming decades as a result of population growth, richer diets and biofuel use. For food production to keep pace, unprecedented amounts of resources – water, fertilizers, energy – will be required. This has led to calls for 'sustainable intensification' in which yields are increased on existing croplands while seeking to minimize impacts on water and other agricultural resources. Recent studies have quantified aspects of this, showing that there is a large potential to improve crop yields and increase harvest frequencies to better meet human demand. Though promising, both solutions would necessitate large additional inputs of water and fertilizer in order to be achieved under current technologies. However, the question of whether the current distribution of crops is, in fact, the best for realizing maximized production has not been considered to date.

To this end, we ask: Is it possible to minimize water demand by simply growing crops where soil and climate conditions are best suited? Here we use maps of agro-ecological suitability – a measure of physical and chemical soil fertility – for 15 major food crops to identify differences between current crop distributions and where they can most suitably be planted. By redistributing crops across currently cultivated lands, we determine what distribution of crops would maintain current calorie production and agricultural value while minimizing the water demand of crop production. In doing this, our study provides a novel tool for policy makers and managers to integrate food security, environmental sustainability, and rural livelihoods by improving the use of freshwater resources without compromising crop calorie production or rural livelihoods.