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How much is global crop production over-exploiting different water resources?

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Although water is a renewable resource and human appropriation is on average lower than availability, water scarcity is a reality in many regions, especially in arid and semi-arid zones. Human and ecosystems compete for water resources; where water is scarce the competition becomes harder. Nowadays, 2 billion people live in highly water-stressed areas where precipitation is scarce, surface and ground water are being depleted. Plant growth is constrained by green water availability as soil moisture, around 60% of global river discharge is under moderate to high threat, freshwater species are imperiled, alarming levels of groundwater depletion have been estimated. Balancing human water requirement and ecosystems water needs through water resources management is a great challenge for many countries. Our study focuses on the water depletion caused by the nine most cultivated crops worldwide. For the first time, we analyse the sustainability of water use for three sources separately: soil moisture, surface water and round water. We explore crop-induced water scarcity through a measure of the water source depletion. Depletion of soil moisture, surface and ground water means that such water supply is not available for their purposes (e.g., sanitation, healthcare, grazing lands, terrestrial and aquatic ecosystems). We compare the annual crop water demand from soil moisture, surface and groundwater with the renewability rate of each water source. When the annual demand exceeds the renewability rate, the water use is not sustainable, as it is leading to a depletion of the water storage. We measure the severity of the source depletion as the number of years required to replenish the source consumed by crops. This newly developed indicator allows one to compare the depletion level of the three water sources at a certain location for specific crops. Hence, we mapped for each crop the number of years required to replenish the water withdrawn from different sources. Each map identifies the hotspots for each water source, highlighting regions and crops that threaten most the human-ecosystem balance.