



Will there be enough water for global food production? Results from an indicator-based model assessment

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Water scarcity is usually being estimated by relating water resources (typically river discharge) to population numbers or, more directly, to human water withdrawals. If water availability falls below a given threshold (e.g. below 1,300 m³ per capita and year), a country, region or river basin is classified as being water-scarce. However, it is questionable whether a single threshold holds for the whole globe, especially when evaluating water scarcity in the context of food production. The main reason is that due to regional differences in water productivities (the amount of biomass produced per unit of water, as controlled primarily by differences in climate and management), the growth of a crop requires different amounts of water in different locations. Also, both the blue water resources (in rivers, lakes, reservoirs and aquifers) and the green water resources (stored in the soil in agricultural areas) need to be considered in such assessments.

This study compares, spatially explicitly and at global scale, per person water availability and water requirements for food production i) for the present (1971-2000), and b) for the future (2070-2099) under conditions of climate and population change. Specifically, the dynamic global vegetation and water balance model LPJmL was employed to calculate the green and blue water availability per capita, and the water requirements to produce a balanced diet (here assumed to be 3,000 kcal per capita and day, and to consist of 80% vegetal food and 20% animal products) under explicit consideration of regional differences in crop water productivity. From these, a new water scarcity indicator was derived that relates the two at country scale.

A country was considered water-scarce if its water availability (green plus blue water resources) fell below the water requirement for the specified diet (being well below 1,300 m³ per capita and year in large parts of Europe where crop water productivity is high, and being significantly higher in many countries of the South). This is presently the case especially in North and East Africa and in southwestern Asia. Under conditions of future changes in climate (derived from 17 General Circulation Models) and population (A2 and B1 emissions and population scenarios), water availability per person will most probably diminish in many regions. At the same time the calorie-specific water requirements tend to decrease in many regions, due mainly to the positive effect of rising atmospheric CO₂ concentration on crop water productivity which, however, is very uncertain to be fully realized in most regions. As a net effect of climate, CO₂ and population change, hence, water scarcity will aggravate in many countries, and a number of additional countries are at risk of losing their present capacity to produce a balanced diet for their inhabitants.