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Water demand for crops may rise in northern Germany under warmer climate

By 2070, there may be insufficient water for irrigation to ensure yields and profitability for some crops currently grown in northern Germany - if the IPCC´s worst case climate change scenario becomes a reality - new research warns. To reduce future demand for water under a changing climate, the study suggests that farmers grow different crops and change their management practices.

In Europe, 44% of water taken from rivers and groundwater is used for agriculture. These withdrawals affect EU Member States' commitments to achieve good status of water as laid out by the Water Framework Directive (WFD). Under the WFD, the amount of water abstracted must be controlled and Member States' River Basin Management Plans need to be adaptable to the changing availability of water in the future.

This study investigated how climate change could affect irrigation to the year 2070, in terms of how much water will be needed per square metre of cropland. As a case study, it focused on the agricultural county of Uelzen, in Germany. In this county an average of 73 millimetres of water is applied per square metre of land (mm/m^2) per year for irrigation. No more than 79 mm/m^2 can be extracted from groundwater for this purpose, under local authority rules.

The researchers modelled future water requirements for crops under the RCP 8.5 emissions scenario, the most extreme scenario described by the IPCC. However, the study notes that it has already been surpassed by actual observations.

They considered water demand under three possible temperature rises by 2070: 'maximum' (a daily average temperature that is 1.7°C higher than it was during 1991-2010), 'medium' (+1.3°C) and 'minimum' (+0.9°C). They considered how the climate would affect soil moisture and the release of water by plants to the air ('evapotranspiration'). They assumed that current cultivation patterns would continue and that crops would be irrigated when the soil's water content drops below 20% of its total capacity to store water. The soil in the county is sandy and does not retain water well.

The results suggest that demand for water is likely to rise under both the maximum and medium temperature increases, and fall slightly under the minimum scenario. It would exceed the maximum water allowance of 79 mm/m^3 in the years following 2064, but only under the maximum temperature rise of 1.7°C. Fourteen millimetres more rainfall each year is expected under the maximum scenario, but this would not be enough to make up for the extra 28.4 mm/yr of evapotranspiration in the higher temperatures.

Under this scenario, it is likely that crops would fail or be damaged more often. Local wetlands may also be endangered by agricultural demand for groundwater. Sugar beet and potato in particular require large amounts of water. For instance, in the time period 2051-2070 under the maximum temperature rise, sugar beet could need around 100 mm/m^2 a year and potato around 90 mm/m^2 a year on average.

Demand for irrigation water would also rise under the medium scenario of +1.3°C, but would stay within regulatory limits. Annual rainfall is expected to rise by 45 mm under these circumstances but evapotranspiration would increase by 5.6 mm/yr. Under the minimum temperature rise scenario (+0.9°C), water demand may fall slightly because more rainfall (+44.7 mm/yr) and less evapotranspiration are predicted (-8.7 mm/yr) in this scenario.

To adapt to warmer conditions in future the study suggests growing water-efficient crops, moving sowing dates to earlier in the year when more rain is expected and using more efficient irrigation technologies, such drip irrigation.

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