

## **Impacts of climate change on abstraction reliability for irrigation during droughts – Policy implications for England**

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In humid climates around the world, supplemental irrigation is critical to buffer the effects of rainfall variability and to assure crop yield and quality. In England, abstraction for irrigation is limited by: i) a maximum volumetric limit specified in the abstraction licence and ii) restrictions on abstraction imposed by the water regulator during droughts. Given regulatory efforts to secure sufficient environmental river flows and meet rising water demands due to population growth and climate change, increasing water scarcity is likely to compound the drought challenges faced by irrigated agriculture in this region. The aim of this study is to assess the impact that climate change may have on agricultural abstraction reliability in England within the context of the abstraction and drought management regimes currently in place, and how the water abstraction reform being developed by the Government could reduce the pressure on more and more limited water resources. Firstly, explanatory relationships were derived between an annual agroclimatic aridity index and actual irrigation abstraction. Secondly, the probability of annual abstraction being close to the maximum limit was calculated for each licence for the baseline (1961-90) and future (2071-2098) period. Finally, the current water resource availability triggers for mandatory abstractions restrictions on spray irrigation licences were used to assess the probability of being under restrictions during drought in each period. The results indicate a significant increase in the proportion of the licence being used in all catchments, representing the greatest risk for abstractors in the future, mainly in the most productive agricultural areas located in eastern and southern regions. In contrast, the likelihood of mandatory drought restrictions increases significantly in central and western England due to the lower buffering capacity of groundwater. Based on our findings, this paper discusses how the reform of the water abstraction licensing system being currently designed could help farmers to reduce their water availability risks. For instance, our analysis shows that a huge percentage of licenses in the country are hardly ever used, and hence the potential for reallocation (through water trading or other mechanisms) is worth exploring. Our results highlight the increasing water availability risks for irrigators in this country, and the need of the farming community and the regulator to adapt and collaborate to reduce the impacts and to increase drought resilience and hence food security.