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# An innovative online tool to quantify the drought risk reduction and costing for on-farm irrigation reservoirs

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Irrigated agriculture is a sector of critical importance for UK food security and economic development, that is experiencing multiple stressors due to rising and competing water demands, increasing environmental regulation, climate-related uncertainties, and droughts. Many UK farmers rely on supplementary irrigation to assure the quality and quantity of high-value fruit and vegetable production demanded by retailers and processors. Proposed changes in water regulation and abstraction reforms threaten to reduce farmers' allocations (licenses or permits) for direct abstraction for spray irrigation.

D-Risk (www.d-risk.eu) is an innovative freely available web-tool, developed by Cranfield University in collaboration with agricultural stakeholders, to support irrigated agribusinesses in understanding and managing their current drought and abstraction risks. D-Risk performs a monthly farm-scale water balance, using information on local cropping and irrigation plans, soils and abstraction licensing, to estimate the annual shortfall in the ability to meet theoretical irrigation demand and annual license usage. It is forced by an ensemble of 100 gridded series of 30-year simulated 'current' weather covering the UK from the 'Weather@Home 2' (w@h2) regional climate model to account for the full range of natural climate variability. The tool then provides a probability distribution function of annual irrigation deficit (volumetric shortfall in meeting theoretical irrigation demands) and license 'headroom' (unused licensed water).

The construction of an on-farm reservoir is a key adaptation response to reducing annual irrigation deficit risks that threaten the economic viability and sustainability of a farm business. However, given the high investment costs, farmers need robust guidance to help them decide on the appropriate reservoir sizing needed to reduce risk to an acceptable level, and whether the associated cost of reservoir construction is economically justified.

Here we develop a framework for sizing on-farm reservoirs to reduce the risk of an irrigation deficit to certain thresholds and for estimating their construction cost for both artificially lined and unlined (natural) reservoirs. This framework, developed in collaboration with industry specialists, is implemented in D-Risk, so that the updated version of the tool can provide comparison between the drought risk both 'with' and 'without' new reservoir storage, associated costs and their sensitivity of the risk reduction to the size of the abstraction license required to fill the reservoir during periods of high flow. We demonstrate the approach and webtool utility with reference to a case study farm in eastern England to explore and quantify the expected drought risk reduction from construction of a planned reservoir.