

Irrigation water security: promoting on-farm reservoirs in the UK

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1 The innovation

"A reservoir is now an essential part of my toolkit for securing water" – a farmer who irrigates field-scale vegetables.

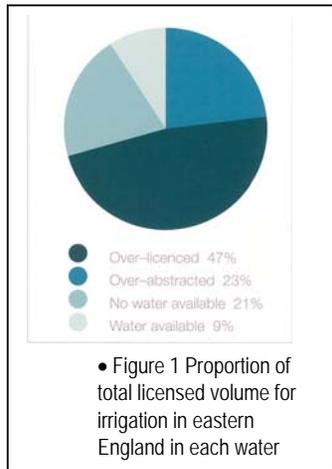
This submission to Watsave describes an innovative programme to promote investment in on-farm storage, the progress made, and the benefits delivered to farmers.

Over the past four years the authors have been actively encouraging farmers, agribusinesses, and water resource managers in the UK to rethink the role of on-farm reservoir storage as a key part of their water resource strategies. As a consequence, UK farmers are again investing in reservoirs in the drier parts of the country, to secure water supplies for irrigating high value fruit and vegetables. Farmers with a winter-filled reservoir have an assured supply for their summer irrigation needs, and the environmental impact of irrigation abstraction is reduced during the summer months when water resources are most constrained. However, there were economic, technical, and regulatory issues to resolve in order to achieve wider uptake of on-farm reservoirs.

1.1 Why this innovation was needed

Irrigated cropping plays a relatively small but highly significant role in agriculture in the UK in terms of food production, rural businesses, and local employment. In eastern England where most production is concentrated the irrigated agri-business value chain supports some 50,000 rural livelihoods and contributes over £3bn annually to the region's economy (Leathes et al., 2008).

Water is at the heart of this industry– without it many farmers would simply not be able to meet the quality and continuity of supply demanded by what is arguably one of the most sophisticated food markets in the world, dominated by supermarkets that can purchase supplies from around the world. Most irrigation water is abstracted from local rivers and streams and is used immediately with relatively little on-farm storage. The volumes are a



very small proportion of the national total water use, but they have significant environmental impact because they are concentrated in the driest parts of the country at the driest times of the year when resources are scarcest (Knox *et al.*, 2010). In England and Wales all withdrawals for irrigation require an abstraction licence or permit. Some 75 percent of the total volume of water licensed for irrigation is located within catchments already under stress in summer months. Over 40% is from catchments that are over-licensed (where unacceptable environmental damage would result if all existing licences were fully used during low-flow periods) or over-abstracted (where existing abstractions are already causing unacceptable damage to the environment at low flows) (Figure 1). Yet, the underlying growth in irrigation water demand is still rising at 2 percent per annum (Weatherhead, 2006). Climate change will increase demand further, while summer river flows and water availability

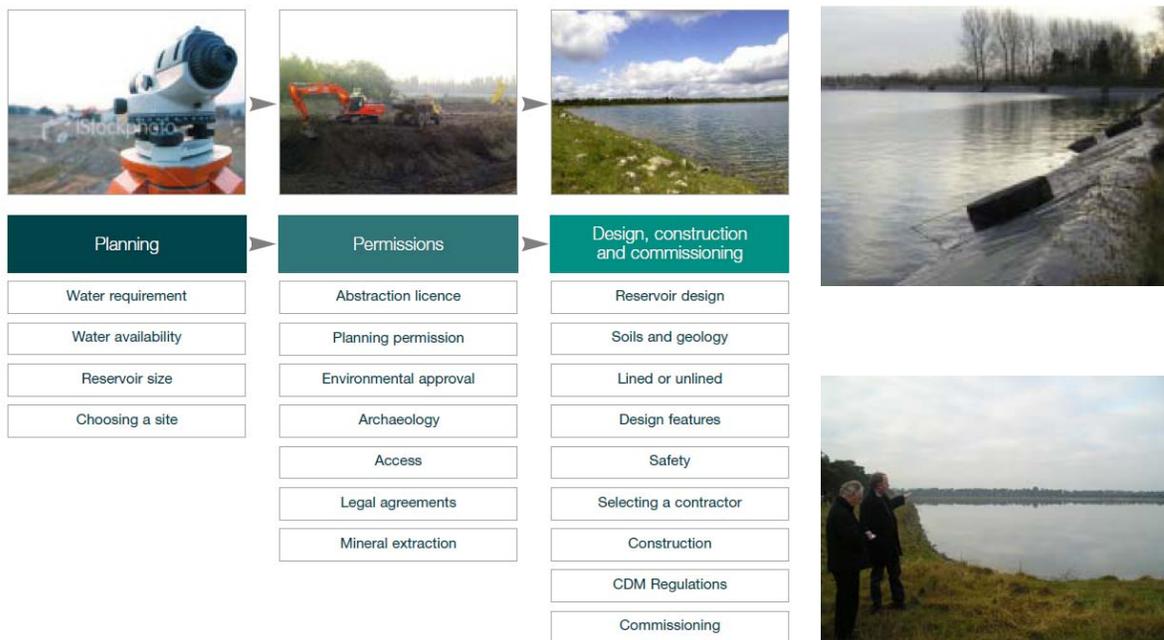
will be reduced.

2 How the innovation saves water

On-farm storage of higher flows during winter seems an obvious solution. Once the water is in the reservoir the farmer can plan the following years cropping and their supply contracts with supermarkets and processors with much greater certainty. Reservoirs store the high winter river flows for use in the drier summer period. The water thus 'conserved' is then 'saved' for other domestic, industrial, and environmental uses during the summer months.

3 How the innovation was introduced and spread

The challenge was how to encourage farmers to take up this option because they have often found there are many obstacles in their way – planning, safety, environmental, leisure, and even archeological – which frustrate reservoir developments and discourage investment. The costs of construction often outweighed the short-term benefits, which are difficult to assess with any certainty under supplementary irrigation. Historically, interest came and went in line with the changes in the weather. A way through this obstacle course was essential to encourage investment and promote wider uptake (Figure 2).



• Figure 2 A way through the obstacle course for farmers wishing to build an on-farm reservoir (from Weatherhead et al, 2009)

The programme focused on Eastern England, where most of the UK irrigation is concentrated. Keith Weatherhead and Jerry Knox had been studying agricultural water resources in the region for many years (e.g. Knox et al., 1997, 2000, 2009; Weatherhead and Knox, 1997, 1999), and had earlier identified the potential for reservoir storage in the region, particularly where clay soils (suitable for clay lining) were in close proximity to the lighter irrigated soils.

In 2006, the authors undertook a major study for the East of England Development Agency (EEDA), the Governments' rural development agency in the region, as it was concerned that future water constraints would impact on the security of some 50,000 rural jobs in the irrigated agricultural value chain. That study involved extensive consultation with key informants in the agri-food industry and other stakeholders with interests in water for food and the environment. The results brought together the views of the farmers, landowners, water regulators and government agencies interested in protecting water, food production, rural employment and businesses.

Three main themes were identified together with a list of actions that need to be taken to secure a fair share of water for agriculture – (i) working together to improve dialogue between farmers, the agri-food industry, and the regulator, (ii) developing a knowledge base to improve water management, and (iii) making best use of available water resources. This latter theme included the construction of more seasonal water storage, particularly shared reservoirs that enabled investment and benefits to be spread amongst groups of farmers. The strategy was published under the title – **A fair share of water for agriculture** – and disseminated to all agri-businesses and others interested in the future of water in Eastern England (Knox et al 2007, see attached pdf).



• Figure 3 Main publications resulting from this programme (see attached pdfs)

Over the next four years the authors worked with key stakeholders in agriculture (notably the National Farmers Union), the environmental regulators (Environment Agency, Natural England), and governmental bodies responsible for business sustainability (Department for Environment and Rural Affairs, and EEDA) actively encouraging farmers across the region to rethink the role of on-farm storage.

Based on the strategy document, EEDA, with funding support from the European Union, developed a programme to financially support the construction of on-farm storage where it would benefit the wider community.

In parallel with this initiative, the Environment Agency, which has regulatory responsibilities for water resources management in England and Wales, was promoting a twin track approach for making best use of existing water resources and encouraging investment in developing new resources by constructing on-farm storage.

In 2009, in support of this national strategy, the Environment Agency commissioned the authors to develop materials for promoting investment in on-farm storage. Reservoir designers, reservoir constructors, local planners, lawyers, environmental groups, archaeologists, banks, and, most importantly, farmers who had recently had reservoirs constructed, were consulted to tease out the costs, the problems encountered, and the solutions.

A detailed technical report and an information booklet for farmers were prepared entitled – **Thinking about an irrigation reservoir? – a guide to planning, designing, constructing, and commissioning a water storage reservoir** (Weatherhead et al, 2009; see attached). This was disseminated to over 2,500 farmers and agri-food businesses across the eastern region

To complement this publication, the authors organised a one-day national conference on reservoirs through the UK Irrigation Association (UKIA) at which the various contributors to the publications were able to publicise reservoir construction not just to the 120 participants but also through the farming press as well. This was followed by a number of specific training initiatives at a more local level and organised visits to farm reservoirs, both constructed and under construction. Collectively, these events raised the profile of on-farm reservoirs and their potential for alleviating water resource stress.

3.1 Benefits and impact

Evidence of the success of the programme can be measured via two sources. One key question is – are farmers now more aware of the costs and benefits of on-farm storage and the challenges they face in the planning process as well as in design, construction and commissioning reservoirs? All irrigation abstraction licence holders received a copy of the booklet, and it is downloadable from the UKIA website. The conference and the training events were very well attended and participant feedback confirmed they found them very useful for their businesses.

'There are so many different things to think about every day when running a farm; you can't be expected to be an expert in everything. Guides like 'Thinking about an irrigation reservoir' are essential for bringing together the wide range of factors that comprise an effective plan for water storage. I was impressed when my regional development officer for agriculture suggested I must have a copy – I already had!' Irrigating farmer in Eastern Region

The strongest evidence for success would be increased on-farm storage as a result of this programme. Unfortunately UK government does not collect on-farm water storage data but there is evidence of farmers applying for grant support. Over the past 6 months, for example, 10 agri-businesses have put forward plans for EEDA grant support for on-farm storage totaling 1.2 million m³ and involving a total private investment of just over £4 million. Five schemes have already been approved, the rest are currently being appraised and are expected to be approved shortly. More are in the pipeline.

4 Scope for further expansion of the innovation

Following the success in the eastern region, further events are expected to extend the programme into the Southern and Midlands Regions where high value crops as also irrigated in areas of water stress.

The authors are also maintaining the momentum of this programme with their involvement in the development and implementation of water strategies for both agriculture and horticulture with funding support from the Environment Agency, rural development agencies (e.g. EEDA), and grower levy boards which provide support to their growers (e.g. Horticultural Development Council). This has provided the necessary framework within which future water issues for growers and the agri-industry are now being addressed.

5 The roles of the individuals nominees

Although this programme involved contributions from many stakeholders across the Eastern Region, the authors played a catalytic role in developing, introducing, and spreading the innovation. Keith Weatherhead and Jerry Knox, Cranfield University, were central to the development of the agricultural water strategy and the reservoir booklet. Cranfield University has an international reputation in agricultural water management and has worked with UK farmers, agribusinesses, and the water regulatory authority since 1980. It has undertaken many studies focusing on water for agriculture in order to improve dialogue between farmers and stakeholders regarding sustainable irrigation abstraction.

Melvyn Kay, Executive Secretary of the UK Irrigation Association, was key to introducing and spreading the innovation – bringing together stakeholder groups, disseminating information to farmers and agri-businesses, and organising the conference and training courses including feedback. The Association was founded in 1980 and has a broad based membership of farmers, consultants, suppliers, researchers, and government staff. It works to support and promote better use of water for irrigation, not just in agriculture but also in sectors such as landscape, amenity, and sports turf. The UKIA is not a trade association but focuses on education to raise knowledge and skills in water management.

By working together, Cranfield University and the UKIA have formed a strong partnership harnessing their respective skills in water management, education, communication, and knowledge transfer to promote the wise use of water across the UK agri-food industry and beyond.

Acknowledgements

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References

- Knox, J W, Kay, M, Hammett, P (2007). A fair share of water for agriculture. Cranfield University, UK.
- Knox, J.W., Morris, J., Weatherhead, E.K., and Turner, A.P. (2000). Mapping the financial benefits of spray irrigation and potential financial impact of restrictions on abstraction: a case study in Anglian Region. *Journal of Environmental Management* 58: 45-59.
- Knox, J.W., Rodriguez-Diaz, J.A., Weatherhead, E.K., and Kay, M.G. (2010). Development of a water strategy for horticulture in England and Wales. *Journal of Horticultural Science and Biotechnology* 85(2): 89-93.
- Knox, J.W., Weatherhead, E.K., and Bradley, R.I. (1997). Mapping the total volumetric irrigation water requirements in England and Wales. *Agricultural Water Management*. 33: 1-19
- Knox, J.W., Weatherhead, E.K., Rodriguez-Diaz, J.A., and Kay, M.G. (2009). Developing a strategy to improve irrigation efficiency in a temperate climate: a case study in England. *Outlook on Agriculture* 38(4): 303-309.
- Leathes, W, Knox, J.W., Kay, M.G., Trawick, P., and Rodriguez-Diaz, J.A. (2008). Developing UK farmers' institutional capacity to defend their water rights and effectively manage limited water resources. *Irrigation and Drainage* 57(3): 322-331.
- Weatherhead, E.K. (2006). Survey of irrigation of outdoor crops in 2005 – England and Wales. Cranfield University.
- Weatherhead, E K, Kay, M, Knox, J W (2009) Thinking about an irrigation reservoir – a guide to planning, designing, constructing and commissioning a water storage reservoir. Cranfield University, UK.
- Weatherhead, E.K. and Knox, J.W. (1999). Predicting and mapping the future demand for irrigation water in England and Wales. *Agricultural Water Management* 43: 203-218.
- Weatherhead, E K, Knox, J W, Morris, J, Hess, T M, Bradley, R.I and Sanders, C.L (1997) Irrigation demand and on-farm water conservation in England and Wales. Final project report to the Ministry of Agriculture, Fisheries and Food. Cranfield University, UK.