Postponing Day Zero: Investment in water efficiency will keep taps running

10 May 2018

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California, Brazil and South Africa have all recently experienced major drought, threatening serious disruption to supplies for major cities ('Day Zero' events). How can England prepare for drought without harming the environment or driving up water charges?

Dr. Matthew Ives and Mike Simpson of Oxford's Environmental Change Institute, discuss their research on strategic water planning, newly published in the *Water & Environment Journal*.

Many people find it hard to believe that a country so blessed with rain as England would have any need to undertake intensive water conservation measures. But, contrary to popular opinion, the United Kingdom isn't as wet as some believe. In fact, some parts of England have rainfall rates per person as low as the world's most arid regions, such as the Middle East.

Convincing people to use less water and investing in long-term leakage reduction solutions will be critical for the avoidance of drought-induced interruptions to water supplies for large numbers of businesses and households in England.

Additional consequences of failure to act would include high costs for new infrastructure, such as for desalination or transfer pumping, while the extra energy this uses may mean additional carbon dioxide emissions. These stark conclusions are the headline results from recently published research into future-proofing England against the spectre of severe drought.

This twin-track approach represents a bold challenge to the water engineering community. Technological and social solutions to address leakage and demand reduction already exist, with many currently implemented in the UK or overseas.

Smart metering, available on a voluntary basis in much of England, can drive down the costs of finding and managing leaks, as well as encouraging reduced use of water. Satellite and remote-sensing technologies pioneered in drier parts of the world, like Israel and California, can be used to identify leakage sites.

The sheer number of people in the relatively small urban areas of England require an enormous amount of water. Unfortunately, while many of the most densely populated areas are in the South and East, much of the rain falls in the North and West. One regularly proposed answer to this problem is to transport water across the UK, in particular from Wales and Scotland, to support temporary dry conditions in the Southeast of England. Could this pipeline idea be a solution? Maybe technologies such as desalination could be used? Or the development of a new generation of larger reservoirs? What about increasing the efficiency of our existing water system?

Developing solutions to meet England's future water needs calls for a national perspective, which can answer strategic questions about our water infrastructure strategy. Using our purpose-built National Infrastructure Systems Model (NISMOD) we assessed all of the different investment options available to England's water companies for future-

proofing the country's water supplies. With a twist. We included the options available to individual companies, such as reservoir extensions and desalination plants, alongside options requiring a national perspective, such as inter-company transfers and demand management campaigns. And we pitted all such options against the spectre of future uncertainty around climate change and population growth.

We termed this analysis 'navigating the water trilemma' as it involved finding solutions that not only provided England with future water security but solutions that were also affordable and did not put too great a strain on the natural environment. This study highlighted the value of the flexible, 'trilemma-friendly' options like leakage reductions and demand reductions.

Our analysis points to the unavoidable answer: leakage reduction and demand management are the most cost effective and widely applicable components of future water strategy for England. Early investment in both of these solutions would allow a sensible and frugal culture of water use to be developed without recourse to panic during the inevitable drought events, such as experienced in the summer of 1976.

When we look at the impacts of drought in places which have the resources of England but have not taken sufficient preparation, the results are clear.

In Australia, hugely expensive new desalination works were developed in response to an extended drought, with long-term costs to public finances. Over recent years in California, restrictions on water use have been seen as deeply socially disruptive. However, many Californians now see responsible water use as a normal part of daily life.

Our research and new modelling capabilities were used to great effect by the National Infrastructure Commission (NIC) in their assessment of England's drought preparedness. Their analysis, produced on the basis of our work, proposes a dramatic and ambitious change in approach. The NIC concluded that the equivalent of an extra 4 billion litres of water per day would be needed across England in case of significant drought. The report proposed that two-thirds of this should be made available through developing efficient pipe systems as well as shifting to the lowest household water use rates in the developed world. The NIC recommended that this should be supported by transfers of water between regions and, where appropriate, new water infrastructure including reservoirs and water recycling schemes.

Without improved national co-ordination and large-scale investment in water supply, the NIC's report suggests that large parts of the country have a one-in-four chance of having their water cut off during a drought. Emergency measures, such as road and ship tankers, could cost up to £40 billion up until 2050, while the costs of building greater resilience would cost only half this amount.

Improving water resource efficiency is a fascinating challenge with many lessons to be learned from around the world. Technological solutions including sensing and monitoring of water supplies can be complemented by social solutions such as education and identifying the factors that influence people to make better use of water. Organisations such as ECI and the Centre for Ecology & Hydrology are well-placed to influence how such ideas are researched and how this research can become reality.

With some planning and vision, water supply in England can be future-proofed and it doesn't have to be expensive. Adequate early investment, the development of a culture of water saving and some new technological and social ideas should make our occasional long, dry summers something to look forward to. When the alternative is expensive, environmentally damaging short-term solutions and regularly running out of water, surely the choice is clear?

More information: Matthew C. Ives et al. Navigating the water trilemma: a strategic assessment of long-term national water resource management options for Great Britain, *Water and Environment Journal* (2018). DOI: 10.1111/wej.12352

Provided by University of Oxford

APA citation: Postponing Day Zero: Investment in water efficiency will keep taps running (2018, May 10) retrieved 11 May 2021 from https://phys.org/news/2018-05-postponing-day-investment-efficiency.html