Water savings from delivery efficiency improvements

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Introduction

Climate change is expected to reduce water availability in the southern Murray-Darling Basin (CSIRO, 2009). In addition, the Water for the Future plan anticipates a return of some water to the environment. The combined effect could be a reduction in the water for irrigation of 30 – 40 %. Drought periods represent much larger temporary reductions (Kirby *et al*., 2010). Coping with this reduction will be a big challenge.

One means of meeting this challenge is to find water savings from delivery efficiency improvements. The Water for the Future plan is about much more than this, but we restrict our focus here to delivery efficiency improvements.

In this paper we use literature values and an unashamedly back-of-the-envelope calculation to make two points: firstly, that there is great uncertainty in the magnitude of savings that might be achieved; and, secondly, that despite the uncertainty it appears unlikely that delivery efficiency improvements will contribute much to meeting the challenge.

Discussion

Diversions, efficiencies and losses

The overall long-term average annual diversions in the southern Murray-Darling Basin are about 8,500 GL (MDBA, 2009).

The system delivery efficiency is generally around 80 % (ANCID, 2007). Thus, the average annual losses to the farm gate are of the order of 1,700 GL.

Breaking down these losses into components is difficult, and there is little published information. Khan *et al*. (2009) estimated the losses of about 54 GL/yr from a 500 km sub-set of the MIA canals, of which about 42 GL was from seepage and 12 GL from evaporation. On the other hand, Murrumbidgee Irrigation (2005, 2009) conclude that between 1998/9 and 2008/9 the total losses from the whole system averaged about 180 GL, with system efficiencies generally around 80 %. The combined seepage and leakage was about 31 and evaporation was about 23 GL per year. Douglass et al. (2000) showed that, on one channel in the Goulburn-Murray system over four years, measured deliveries were 76.5 %, seeps and leaks were 4.3 %, and evaporation was 1.3 % of diversions.

Extrapolating to the rest of the southern Murray-Darling Basin must be taken with a large dose of scepticism, since the systems vary considerably. However, it seems not unreasonable to suppose that of the 1,700 GL annual delivery losses, not more than 30 % is due to channel losses of which more than half is due to seepage and leakage. Seepage and leakage could therefore amount to about 300 to 450 GL annually.

Another component of loss is due to metering errors. According to Hydro Environmental (2008), Dethridge wheels generally underestimate by an average of 6.9 % (range – 3 to +18 %). Goulburn-Murray Water (2010) on the other hand suggest that the under-estimation is of order 10 %. If we take a mid-range value of 8 % for metering under-estimation, then across the southern Murray-Darling Basin this would amount to an error annually of 680 GL.

The annual losses of water unaccounted for in the above estimates varies from about 170 to about 500 GL annually. This includes evaporation, losses outside the channel system (such as lakes and storages), unaccounted escapes and uses, and other metering errors.

Return flows

There are very few estimates of return flow. Van Dijk et al. (2005) assumed that return flows were 8 % of diversions in the Murrumbidgee and 10 % as an average across the

Murray-Darling Basin. The return flows comprise returns from both the delivery and on-farm systems. Nevertheless, the assumption of Van Dijk et al. amounts to a substantial fraction of the overall losses of 20 % and a larger fraction of the seepage and leakage losses.

The prospect for delivery efficiency savings: lining channels

Lining or otherwise reducing seepage and leakage from channels appears to offer the prospect of saving between 300 and 450 GL annually (in years of average diversions, but less in drier years), but only if the improvements capture 100 % of the losses. This appears very unlikely, and would be prohibitively costly. Savings will therefore be much less on cost grounds, less in dry years, and less because of return flows.

The prospect for delivery efficiency savings: better metering

More accurate meters offer the prospect of saving perhaps 680 GL/yr. Again, it is improbable that 100 % of the savings will be realised. It is reasonable to suppose that with more accurate meters a large proportion could be saved. This saving, however, while it may appear to be an unaccounted loss, is in fact water that is used. Any of this saving used in irrigation would appear to result in no net gain. Accounting for the benefit gained from this saving therefore requires careful consideration.

The prospect for delivery efficiency savings: other

In addition to the prospects above, there may also be savings from changed operations, and re-designed or reduced channel and storage layouts, both of which would save evaporation losses in addition to seepage and leakage losses. We do not consider these prospects here.

Conclusions

In conclusion, we reiterate our two main points: firstly, that there is great uncertainty in the savings that might be achieved by improving delivery efficiency; and, secondly, that despite the uncertainty it appears unlikely that savings will contribute much to meeting the challenge of reduced water availability. Delivery efficiency improvements may be desirable on other grounds, such as developing a better managed system. Improvements will require careful assessment of the uncertainties, of which return flows are the least well known.

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