Perspectives on improving water use efficiency in irrigated agriculture

A submission to the Inquiry into Water Use Efficiency in Australian agriculture

Peter A Smith, Sapphire Irrigation Consulting

Introductory comments

Irrigated farms are significantly more productive than rainfed (or dryland) farms. Agricultural Irrigation production figures in 2014-15 from the ABS show the following:

- Total agricultural area: 384,557,865 Ha
- Total irrigated area: 2,149,000 Ha
- Water diverted for irrigation: 8,950,298 ML
- Gross value of all agricultural production: $53.6 billion
- Gross value irrigated agricultural production: $15.1 billion

That is, while irrigated agriculture uses the largest proportion of extracted water (around 60%), irrigation farms produce **28% of agricultural value** from **less than 6%** of Australia's agricultural land area. This in itself justifies investment of government and private funds in continually improving irrigation productivity. Much of Australia's domestic consumption of food and fibre comes from our irrigated farms. The potential to increase food and fibre production for export to areas of poor food security is an opportunity Australian irrigation producers are well positioned to actively benefit from.

However, caution is needed in defining water use efficiency and especially where this is equated with irrigation efficiency. Water use efficiency is defined as the amount of production per unit of water applied. (It is not really a true 'efficiency' because it does not compare categories with the same units – it is better termed a 'water use index'.) Irrigation efficiency is defined as the amount of water applied compared to the amount of water used productively (it is a true 'efficiency'). The quest for improved irrigation efficiency as a way to improve water use efficiency is premised on the notion that too much water is currently being used in the production of produce ie. that overwatering or excessive losses are occurring. Where this is the case, improving irrigation efficiency will be achieved by reducing water use while maintaining or perhaps improving productivity, which amounts to an improvement in water use efficiency (or water use index). However, the simplest way to improve irrigation efficiency is to under-water crops – because this means all of the water applied is used by the crop. By this definition, many farmers already have high irrigation efficiency. But their water use efficiency will not be high, as under-watered crops do not yield to their maximum. In this situation, an improvement in water use efficiency will be achieved by *increasing* water use as this will lead to a larger increase in production.

Increasing water use efficiency (or 'water use index') is a goal to continually strive for, whereas irrigation efficiency is just one measure for assessing how well this is being achieved and is not a good goal on its own.

My history with WUE initiatives

Over the past 20 years or so, I have been involved in a number of programs designed to improve water use efficiency in Australian irrigated agriculture. These include the Land and Water Management Plan initiatives (specifically the Berriquin LWMP), the 'WaterWise' program in NSW, the CRC for Irrigation Futures, 'Sustaining the Basin' in the northern Murray-Darling Basin, and most recently the 'Smarter Irrigation for Profit' program (specifically the dairy demonstration farm at Loomberah near Tamworth, NSW). The aims of each of these programs was a little different and showed a progression of including a broader range of pertinent factors, and each program was successful in its own way.

The Land & Water Management Plans were primarily aimed at addressing environmental issues such as high water tables and salinity which were mainly the result of poor irrigation layout and practice. They used a raft of strategies to minimise losses from supply and drainage infrastructure and accessions below the root zone in the irrigated field. The strategies included incentive funding to improve on-farm infrastructure and education in better irrigation management. In the main, the results validated the approach. However a flaw was evident in that farmers could spend increased funds to improve their irrigation efficiency yet become less financially viable. This was captured in the somewhat tongue-in-cheek but not completely untrue notion that becoming the winner of an annual irrigated farm competition in the Riverina-Murray region (the IREC Irrigated Farm Competition) meant that you were next in line to go broke.

The 'WaterWise' program in NSW had a similar structure of incentives and education with the difference that these included a whole-farm approach to planning, identification of opportunities for improvement, and delineation of a plan for action. The four-day educational course was itself subsidised and was a pre-requisite for obtaining further incentive funding. The length of this training allowed for more thorough learning by the participants of key aspects for improving their irrigation performance. Part of this training was to examine their business goals, succession planning, etc. While this was still relatively rudimentary, it necessarily meant profitability and viability of the farm business was included in the water use efficiency planning. A greater level of incentive funding for undertaking a comprehensive farm plan (an 'Irrigation Drainage and Management Plan' or IDMP) resulted in better planning and better outcomes. This was supported by a more generous incentive funding scheme for implementing on-farm improvements that were in accord with the IDMP. The outcomes of the 'WaterWise' program were examined by the NSW Auditors office and found to provide a healthy multiplier benefit. Anecdotally, more than 10 year after this program concluded, I still hear comments from participants that it was one of the best programs they have ever been involved with. To my knowledge, no participant went broke or had reduced viability due to this program.

I was involved in the CRC for Irrigation Futures program as the 'Summer Rainfall Zone' co-leader for the duration of its seven-year life. The approach of this CRC was to lift the level of collaborative research into irrigation by identifying and funding clearly relevant research projects and by increasing the capacity in the irrigation industry by funding around 50 advanced studentships, mainly PhD level. The original concept included a dual-pathway interaction with the irrigated farming community (ie. input from farmers into research planning and effort, along with research output and strategies for adoption of research findings by farmers and other end-users) but this soon gave way to the governance which was over-weighted with research interests. While there were some very good outcomes which are having a continued effect, a disappointment to me was that, at the beginning of the CRC, it was informally acknowledged that achievement of one of the major goals of the

CRC, doubling water use efficiency, could have been achieved simply by increasing adoption of what was already known at that time. The minimising of the adoption strategy was therefore a poor move, and my perception of the irrigation industry is that less than desirable uptake of well-established knowledge still persists.

The 'Sustaining the Basin – Irrigated Farm Modernisation' program was developed primarily to achieve a transfer of existing water entitlement from commercial irrigators in the Murray-Darling Basin to the Commonwealth Environment Water Office to be used for the benefit of the environment. The underlying strategy was to improve irrigation efficiency, and therefore hopefully increase water use efficiency, by reducing on-farm irrigation water losses. This would then enable a proportion of the 'lost' water to be formally returned the CEWH and the remainder made available for the irrigator to use productively. The prime mechanism was a large subsidy to the farmer toward the improvement of on-farm irrigation infrastructure. This program has had a very positive effect in the irrigation communities by the injection of funds to the retail irrigation sector for improved infrastructure, the improved on-farm irrigation performance as a result of the improved infrastructure, and the confidence boost evoked through the investment in the irrigation managers in place of an extensive period of vilification of irrigators. The deficiencies of this program are that it does not have any requirement to examine the infrastructure investment from a business perspective, so the co-investment from both the Commonwealth Govt and the farmer could possibly be misdirected, and the lack of compulsory and rigorous upskilling of irrigation managers. The latter is particularly important because efficiency improvements are only partially achieved by upgrading irrigation infrastructure – how the infrastructure is managed is at least half the story for improving irrigation efficiency and water use efficiency. Another flaw in this program is the central push to improve irrigation and water use efficiency in isolation. The majority of irrigated land and the majority of irrigation water entitlement in Australia uses surface irrigation (sometimes referred to as 'flood' irrigation). An improvement in irrigation efficiency can often be achieved by adopting a form of pressurised irrigation. The problems are that the increased operating costs may prejudice the viability of the farm business and that the manufacture and operation of pressurised systems is more energy intensive than surface irrigation systems. The result may therefore be improved water use efficiency but decreased energy use efficiency and perhaps decreased profitability of the irrigated enterprise.

The 'Smarter Irrigation for Profit' program which is currently running adopts a more comprehensive approach to improving water use efficiency. This approach is conceptually superior to the preceding programs as it includes a range of key factors, such as irrigation efficiency, productivity of the crops and pastures, fertiliser inputs, energy costs, etc. Rather than maximise the output from any single factor, this approach optimises the use of all factors with profitability being the integrator. Having been involved in one demonstration farm for a year and a half so far, the objective of improving water use efficiency is being achieved along with improvements in the other factors. Most importantly, the profitability is also improving so the farmer has increased ability and incentive to apply these principles further and into the future. The biggest deficiency that I see is the lack of formal training for the famer in skills such as irrigation management, energy management, pasture or crop management, fertiliser management, etc. The demonstration farm component of this project means one farmer is intensively coached in all of these factors but translating the impact into the broader irrigated farming community is likely to need extension and education and training that can be cost effectively applied to greater numbers of irrigation farmers.

Important areas for renewed focus

An important aspect of improving irrigation water use efficiency is not to consider one type of irrigation system as a 'silver bullet' which, if broadly adopted, would bring an amazing broad-based improvement. Extensive research and field measurements of commercial systems show that all systems can reach a fairly high level of performance, and, conversely, all systems can achieve quite low levels of performance. While the type of system has some bearing on the performance that can be achieved, of much more significance are the following:

- How well the system is designed
- How well the system is constructed/erected/installed
- How well the system is maintained
- How well the system is managed

The last of these is the most significant as a first-rate system that is poorly managed will achieve low water use efficiency and an average system that is managed well can achieve quite high water use efficiency. While there have been great improvements in the tools and strategies available to help with management, and there is increasing automation of the management activities particularly commencing and ceasing irrigation, in most cases, especially in broad-acre and/or high-value crops, leaving the outcome completely to automation is rarely practised and rarely achieves consistently good outcomes. The skill of management comes from a well-informed manager who can competently interpret the information from various inputs and sources to bring about the optimum yield and quality in their produce. The need to continue upskilling irrigation management in Australia is still great.

The other three factors of design, installation and maintenance are often inadequately applied in Australian irrigation. The result is poorly performing systems that will prejudice good water use efficiency and/or cost a lot to rectify. Improvement in these areas is best achieved by an industry accreditation scheme to allow sound practitioners to be readily identified and engaged. As it is in the interest of governments and regulators as well as irrigators, such a scheme should be encouraged by all levels of government and awareness-raising amongst end-users should be part of an education strategy.

New areas for focus

Applying water by irrigation is just one component in a range of factors an irrigation manager must juggle to achieve good productivity and maintain profitability. Two others that are increasing in importance are the use of energy and fertiliser.

Energy costs are rising and it appears they will do so steeply in the near future. Environmentally, energy use should be kept to a minimum to avoid greenhouse gas production and consequent environmental and climate impacts. The interaction between energy and water use efficiency, particularly on a life-cycle basis, is an area where there is already much knowledge that could be applied and where there is a need for more research to provide better guidelines as the availability and mix of energy sources changes.

The efficient use of fertiliser is also an area that needs more research. Commonly, only a proportion of fertiliser applied to Australian farms ends up being used by the plants. A lot ends up just below the root zone, in a nutrient 'bulge', or washed into surface or subsurface water sources. This is wasted expense for the farmer, creates potential for adverse environmental effects, and is wasting a resource that in some cases is becoming critically short. Fertiliser applied through irrigation, termed 'fertigation', is a convenient way of feeding

crops smaller doses of nutrient via a medium that the fertiliser needs (water) for effective uptake and, if done well, places it in the root zone exactly where and when it is needed. While fertigation is already practiced by many irrigation farmers, there is much scope for greater use of this technique and much need for better guidelines across a range of fertilisers and crops.

I have already mentioned automation, but with increasing technological capability and decreasing cost of technology, research and development of the use of technology to provide more comprehensive and precise information as well as how this might be automated is needed. There is already good work occurring here, but progress is relatively slow and for uptake to occur, the benefits must be clearly demonstrated and reliability must be high.

Recommendations for future investment

My recommendations for future investment in water use efficiency are:

- Increase understanding of irrigation system types, their applicability to particular crops and situations (soils, topography, etc.) and the implications for management and maintenance of each option
- adoption of better management practices
- research and extension of guidelines for efficient use of energy and the trade-off with water efficiency that sometimes results
- research and adoption of better fertiliser use efficiency in irrigated systems
- research and development into use of technology for improved irrigation performance

Note: For brevity, I have not included or specifically cited any reference sources. I am willing to provide these if requested.