

Technological change in the Australian irrigation industry: Implications for future resource management and policy development

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Summary

Recent research sponsored by the National Water Commission explores the trade-offs between water savings, energy use (and greenhouse gas emissions) and economic gain through the implementation of more water efficient, but more energy intensive forms of irrigation technologies on-farm.

The study shows, through a series of case studies and scenarios, that converting to more water-efficient pressurised irrigation systems can result in significant water savings and economic returns for the cropping scenarios analysed. Using a range of assumed carbon prices, the costs associated with increases in greenhouse gas emissions for most of the case studies did offset the economic gain but this was not as influential as water savings, productivity gains and labour savings.

Background

The study developed a framework to assess the effectiveness of different irrigation technologies (surface *gravity-based*, *sprinkler* and *drip irrigation*) used at farm level and to evaluate tradeoffs between various choices of irrigation technology adoption in terms of irrigation requirements, water savings, energy and greenhouse gas emissions (GHG) and relative costs of irrigation and associated equipment.

This framework was applied to farms in inland southern Queensland, with insights provided for the broader Australian irrigation industry through national water transformation scenarios using an integrated framework.

Enterprises assessed during 2010 study included three cotton farms on the Darling Downs, a vegetable (lettuce) farm in the Lockyer Valley and a pasture-cropping (lucerne, oats) and vegetable (onion) farm on the southern Downs (all in southern Queensland). Irrigation technology transitions investigated were from flood (furrow) to overhead sprinkler (lateral-move and/or centre-pivot), from flood (furrow) to drip (trickle), from overhead sprinkler (hand-shift) to drip (trickle), and from overhead sprinkler (roll-line) to improved overhead sprinkler (centre-pivot) systems.

Trade-offs and optimising outcomes

The project aimed to help irrigators optimise water savings, energy and greenhouse gas emissions and relative costs of each irrigation technique. The potential impact of a price on carbon emissions was also included in the analysis.

Trade-offs between water efficiency and production benefits and the additional energy use associated with the adoption of new technologies were evident. While the new irrigation technologies used less water per hectare of crop, irrigation-related GHG emissions per ML of water and per hectare increased significantly with the adoption of new irrigation technologies. However, this was offset in some instances by a reduction in GHG emissions resulting from reductions in the use of farm machinery in farming operations and/or in agrochemical-related emissions (fertiliser,

pesticide etc). Overall, due to increased production, GHG emissions per kg of crop yield fell in most instances.

The conversion of older inefficient and energy-intensive sprinkler irrigation systems (hand shift and roll-line) to drip and efficient sprinkler irrigation technologies saves considerable energy (and GHG).

Economic returns

The economic modelling shows that if average to higher levels of water savings are achieved, conversion to more water efficient irrigation technologies can be economically efficient, especially for horticultural crops because of increased productivity and labour benefits. In terms of economic returns there was not much difference between drip and sprinkler irrigation systems. However, since drip irrigation is mostly adopted for horticulture crops, it generally shows better economic returns.

Water efficiency

Significant water savings were achieved through conversion to more efficient irrigation systems (on average 15-25% water savings are possible). The level of savings depended on climatic conditions, soils and management. Savings ranged from:

- For conversion to sprinkler irrigation: 0.1 to 1.3ML/ha for broad acre crops under sprinkler irrigation systems; and
- For conversion to drip irrigation systems: from 3.0ML/ha (for cotton) to about 4.2ML/ha for lucerne under drip irrigation systems.

Energy efficiency

Energy consumption varies considerably depending on the type of irrigation system used. Surface irrigation systems were assumed to be gravity-fed, requiring no energy to operate. The results showed that drip irrigation systems require 28 per cent less energy than centre pivot and lateral move systems.

Greenhouse gas emissions

Conversion from surface irrigation to more water efficient irrigation increased greenhouse gas emissions (e.g. through increased energy requirements for pumping):

- Centre-pivot irrigation systems run with electric pumps increased greenhouse gas emissions by 906 kgCO₂e/ML.
- Drip irrigation systems run with electric pumps increased greenhouse gas emissions by 568 kgCO₂e/ML.

Conclusions

The report suggests that priority should be given to replacing older inefficient and energy-intensive sprinkler irrigation systems such as hand shift and roll-line. This will not only save water but also save considerable energy in addition to GHG reductions due to improved farming operations. This creates a win-win situation where water savings and GHG reductions can be achieved both as a result of technology adoption and farm-level input.