Is it worth converting furrow irrigated cotton to drip?

By Kasia Mazur[1] and Graham Harris[2]


A drip system installation on the Darling Downs.

Concern about declining water supplies has increased interest in potentially more efficient alternative irrigation systems such as drip irrigation. A major limitation to its broader adoption is the high initial capital outlay, which can be double that of other methods. But the potential increase in crop yield, water savings and reduced labour costs have encouraged adoption by farmers.

Last season, we investigated the long term (10-year) economic benefits and costs of converting furrow irrigation to permanent subsurface drip irrigation (SDI) and non-permanent drip irrigation (NPDI) on the Darling Downs.

The modelling was done on a theoretical cotton farm which utilised 500 ML of water on 142 hectares with drip irrigation. Initially this land was furrow irrigated on 100 hectares. The analysis assumed a 30 per cent water saving and 15 per cent yield improvement as a result of using drip irrigation — figures based in advice from co-operating irrigators with experience in drip irrigated cotton production on the Darling Downs. The 30 per cent water saving enabled 42 per cent more land to be irrigated. The analysis was performed for Bollgard II cotton planted on a heavy clay soil.

The study investigated three possible scenarios:

Scenario 1 — the area planted to cotton expanded to 142 hectares where drip is installed;

Scenario 2 — as for Scenario 1 but with the impact of one year without sufficient water to grow any irrigated crop; and,

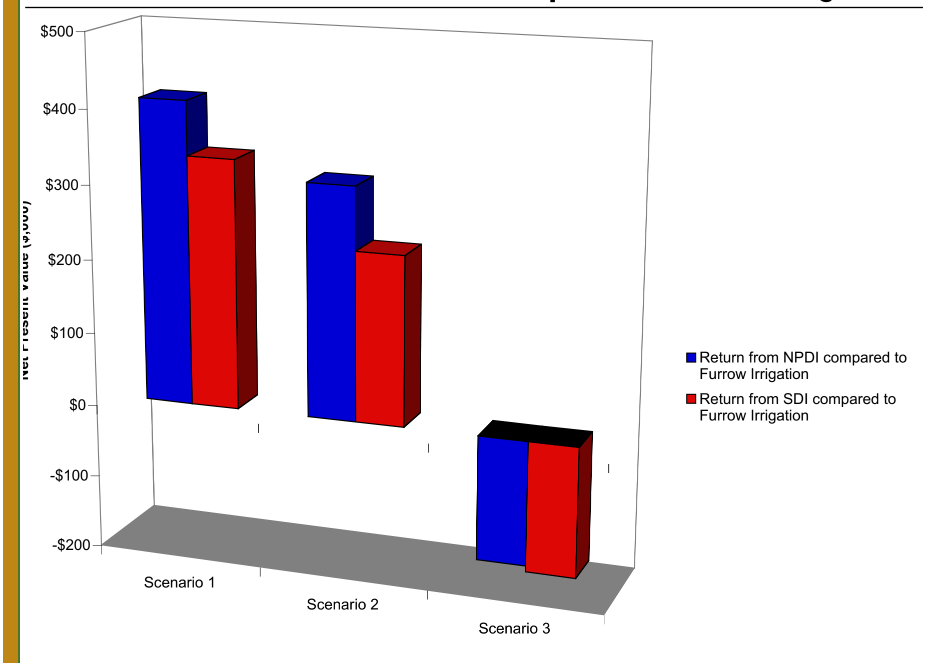
Scenario 3 — the irrigated cotton area remains at 100 hectares despite the 30 per cent water savings using drip irrigation.

The adoption process of drip irrigation systems can take two to three years to achieve potential benefits (30 per cent water saving and 15 per cent yield increase). The analysis accommodated this delay, assuming 80 per cent of the possible benefit in year one for SDI systems, 90 per cent in year two and 100 per cent in years three to 10. For the NPDI system, which is easier to manage, the efficiency was assumed to be 90 per cent in year one, 95 per cent in year two and 100 per cent from years three to 10.

The study found that investment in converting furrow irrigation to drip irrigation systems can generate a 20 to 30 per cent increase in revenue, provided the irrigation area is expanded as a result of water savings. The analysis also showed that higher water prices, reduced water allocations and the possibility of selling water on the market further enhance the benefits of investment in drip irrigation systems (see Figure 1).

In this example, cotton production

FIGURE 1: Benefit of NPDI and SDI in comparison to furrow irrigation



under drip irrigation generated an extra $410,000 for NPDI and $337,000 for SDI over a 10 year period (Scenario 1) compared with furrow irrigation. The best return was generated by NPDI if the drip tapes were used for two seasons. If the NPDI tapes are replaced every year, the yield and increased area benefit doesn't cover the cost of the drip equipment. The benefit from the SDI system is about 18 per cent lower than the NPDI, because of the much higher investment costs of SDI.

If the water availability is reduced during the project life (Scenario 2) the profitability of drip irrigation is reduced by 23 per cent for NPDI and by 32 per cent for SDI. SDI is more sensitive to changes in water availability due to its higher fixed costs.

With NPDI systems, drip tapes are replaced regularly. This means a greater proportion of the costs is variable, and can be avoided if water is unavailable. Despite the lack of water in one year, NPDI and SDI still generate higher returns than furrow irrigation because of the additional planting area. If there is a high degree of uncertainty in water availability over the project life span, the greater flexibility of NPDI is likely to be advantageous.

In Scenario 3 (where the area of cotton production was not expanded despite significant water saving from drip irrigation), the benefit obtained from yield improvement does not offset the cost of drip irrigation equipment. But the analy-

64 ▷

sis found that in some situations, the 15 per cent yield improvement from using drip irrigation is able to cover the cost of investment, even when the area of cotton production is not expanded. This situation only occurs if:

- The cotton price is higher than $700 per bale for NPDI and $755 per bale for SDI. This is because the 15 per cent increase in yield is able to cover the price of the drip equipment.
- The water allocation for the farm is reduced by 30 per cent, so the 30 per cent water saving from drip irrigation allows farmers to continue cotton production on the same area. A water allocation reduction in excess of 30 per cent would restrict full utilisation of the drip system — a further barrier to adoption.
- If the opportunity cost of water is higher than $145 per ML. In this case, the water saving from drip irrigation can generate potential profits through selling the surplus water.

VERY SENSITIVE

The investment in drip irrigation is very sensitive to changes in the cotton price. The benefit from using drip irrigation increases when the cotton price increases.

But the cotton price has to be higher than $360 per bale for SDI and $345 per bale for NPDI. Below this price, the return on investment does not fully cover the costs of drip equipment.

Figure 2 shows the break-even points at which cotton production under drip irrigation systems become more profitable than under furrow irrigation for the assumptions in this analysis (the horizontal axis at a NPV of 0 represents cotton production under furrow irrigation).

The sensitivity analysis for the price of drip irrigation equipment shows that a 10 per cent increase or decrease in price changes the benefits by 18 per cent for SDI and 14 per cent for NPDI. SDI is more sensitive to changes in equipment pricing than NPDI because it involves higher equipment costs.

On the other hand, as components of NPDI need to be replaced regularly, they are subject to year-by-year price fluctuations. With the SDI system, the irrigator buys all the parts in the first year and there is no further investment in the following years — so any future price fluctuations have no impact on the project.

The sensitivity analysis also investigated the situation where the water saving from using drip irrigation was 20 per cent rather than 30 per cent. The lower reduction in water saving reduced the benefit from using drip irrigation by about 45 per cent for NPDI and 40 per cent for SDI.

Overall, the study showed that NPDI is a more flexible and least risky drip system. But success of this investment requires detailed analysis of each farm situation and good management practices to realise the potential efficiencies of these systems.

FIGURE 2: The break-even points for investment in drip irrigation for various cotton prices

Thanks to the co-operating farmers from the Darling Downs — Andrew Bartley, Ian Hayllor, Stuart Higgins, Scott Seis, Paul McVeigh — and Stuart Moxham of T-Systems Australia. Funding support for this Masters was provided by the Department of Primary Industries and Fisheries and the Rural Water Use Efficiency 2 project.

[1] Former Masters student, Natural Resource Economics, University of Queensland.

[2] Dept of Primary Industries and Fisheries, Toowoomba.

Kasia Mazur and Stuart Higgins.

Kasia Mazur (right) discusses the drip system with Scott Seis.