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WATER MANAGEMENT
case study

Increasing water use efficiency
at Boggabri

Improving water use efficiency (WUE) with overhead sprinkler systems

Irrigated cotton makes up 70-80 per cent of the "Kilmarnock" business, however as irrigation supplies have been reduced, Andrew Watson's farming operation has had to increase water use efficiency in his farming operation.

Andrew says the 'millennium' drought prompted him to make improvements in irrigation management and to install new infrastructure. Those changes have resulted in higher crop yields produced with less water.

With sufficient bore water to grow about 260ha cotton annually, Andrew (pictured) has invested in overhead lateral move irrigation systems to increase water use efficiency on this area of cotton.

The first of two swing around laterals was purchased at a cost of around $450,000 in 2013, with a return on investment anticipated in 3-5 years. The second was built in 2014.

A third lateral move irrigator was built to commence operation in the 2015-2016 season. Plans for the installation of a centre pivot system were also in progress.

However Andrew believes the cost is too great to justify installing similar infrastructure on country irrigated by less reliable water supplies from Keepit Dam.

"To be economic, we need to make use of the laterals every year, so if we built anymore we wouldn't have enough water to fully utilize them. There's no return on the asset if you are not running them."

Background:
"Kilmarnock", Boggabri, Upper Namoi, NSW

- **Area farmed:**
  Irrigated: 900 ha
  Raingrown: 1200 ha
  Grazing: 100 ha
  In 2015, Andrew Watson had leased extra country consisting of 950 ha under irrigation, 1100 ha raingrown and 100 ha grazing.
- **Crops:**
  Irrigated cotton and durum wheat.
  Raingrown durum, canola, chickpeas, sorghum.
- **Rainfall:**
  590mm long term average rainfall (Significant variation in actual annual rainfall is not reflected in long term average totals).
- **Irrigation water:**
  Drawn from both river and ground water, with 19 bore sources supplying about 50 per cent of total supplies (enough to irrigate about 260ha cotton annually), and remainder drawn from the Namoi River (via Keepit Dam).

Andrew now has two years of wheat data and three years of cotton data under his lateral move sprinkler systems. In two out of the three years, water savings have been recorded (Table 2).

"We've already seen a substantial water saving of one ML/ha water per hectare, comparing furrow with lateral move irrigation (7.5 ML vs 6.5 ML)," said Andrew.

"Saving a megalitre of water is significant! We have seen a 15-17 per cent water saving in total in the 2014-2015 season. If I can save this kind of water every year, I'm well ahead in the long term.

"Potentially we think we could produce the same amount of crop with 25 per cent less water compared to the furrow system.

"You could argue that you save more water in a wet year because you can take advantage of a forecast rainfall event by not fully saturating the soil profile, applying smaller amounts of water until rain arrives, which manages plant health and reduces water logging.

"However in a flood irrigated field, a full irrigation is required."

In 2013, Andrew's first year using overhead irrigation, the lateral move system achieved a 17 per cent yield gain with 12 per cent water savings, compared to the furrow system.

"In a very dry season 10 or 12 years ago, we used 8-9 ML/ha across the farm, whereas in 2014 we used a total of 7 ML/hectare.

"We have well structured soils, with generally high levels of organic matter, compared with other fully irrigated cropping land (1.2–1.4 per cent), which assists in getting good uniformity of water distribution.

"I think growing irrigated wheat in the off season has helped organic matter, giving us a lot of straw to turn back into the soil.

"With the sprinklers we are also changing how we apply the water, eg a light rate of 10mm down, then more in the next pass (up to 40 mm), with increased intervals between passes, so that the water will soak further into the ground and hence with a larger root zone, roots will be deeper and more resilient."

Table 1: Area under overhead irrigation

	Side 1	Side 2	Capacity
Swing around lateral move 1	64 ha	69 ha	11 ML/day
Swing around lateral move 2	70 ha	59 ha	9.5 ML/day
Swing around lateral move 3	54 ha	54 ha	7 ML/day
Centre pivot	91 ha		11 ML/day

Table 2: Water use efficiency: furrow vs lateral move

	2013	2014	2015**
Furrow system – water use (ML/ha)	6.8	7.8	7.5
Lateral move - water use (ML/ha)	6.1	8.5	6.5
Furrow yield (b/ha)	11.1	10.3	12.25 b/ha (estimate)
Lateral move yield (b/ha)	13.1	11.0	12.15 b/ha (estimate)
Furrow - IWUI* (b/ML)	1.63	1.32	1.63
Lateral move - IWUI* (b/ML)	2.15	1.29	1.87

*IWUI (Irrigation water use index): relates total production compared to the amount of irrigation water supplied, and is a performance indicator used to assess water use efficiency (WUE).
**Significant impact of Verticillium wilt may have skewed the 2015 results.

Water application on "Kilmarnock":

- Data from surface irrigation performance evaluations conducted in the 2006-07 season demonstrated Andrew is achieving application efficiencies above 90 per cent for individual irrigation events. Distribution uniformity ranged between 80-90 per cent.
- Two swing around lateral move irrigators currently operating, with a system capacity of 14 mm water application per day. A third lateral move irrigator has just been built and will operate next season. A centre pivot system is also soon to be installed.
- Fitted with fixed sprinklers (Nelson D3000) on one meter spacings (creating overlap) to improve the instantaneous application rate and water infiltration.
- Half sprinklers are used around the wheels (with increased nozzle size) to reduce rutting/bogging issues, and ensure even cotton around wheel tracks.
- Labour efficiencies: one staff member can run three laterals, watering 180 ha per year.

For more:

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- the CottonInfo website: http://cottoninfo.com.au/water-management

Key definitions:

- **Application efficiency:** relates the amount of water applied in an irrigation to the amount of water available to the crop for use. High efficiency indicates most of the water applied has remained in the root zone available for plant use. Low efficiency means much of the water has not reached or has moved out of the root zone, giving no benefit to the plant.
- **Distribution uniformity:** is a measure of how evenly water has been applied. Low distribution uniformity is caused by an uneven opportunity time along the length of the furrow. As a result parts of a field will be under-watered or over-watered.