Irrigating more profitably…

The Low Hanging Fruit

The key findings of dairy irrigation trial and demonstration sites in NSW’s Hunter region over the past five years indicate:

- Common industry practice is to delay irrigation start-up to “save” on costs associated with water, energy and labour use. Project site participants have all commenced irrigation 3-4 weeks earlier than their usual scheduling practice.

- The most expensive water is the water never applied. By not monitoring soil moisture, irrigators become limited by the capacity of their systems and the season ahead becomes a catch-up battle as ETo increases. This results in lost opportunity to optimise pasture/crop growth from irrigation assets. It also increases the likelihood that peak power use will be required to keep soil moisture in the RAW- a hit to farm profit again.

- Best guess standard application rates and timing result in over or under-watering, impacting upon ideal opportunities to use nitrogen (N) efficiency to optimise production and profit.

- System maintenance procedures are generally poor resulting in equipment that is underprepared to operate when needed or at optimal efficiency- a waste of water, energy and opportunities to optimise plant growth.

Key rules of thumb in making irrigation decisions:

- Employ two irrigation decision fundamentals:
  1. Monitor soil moisture using incremental sensors to a depth 10cm below the rooting zone, automatic logger and telemetry for ease of use. The sensors provide a measurement of effective rainfall and irrigation on soil moisture. You can use one probe to self-calibrate for other soil types across the farm to lessen the initial costs.
  2. Use a free weather-based irrigation scheduling tool so that a general water balance can be calculated and a recommended irrigation schedule determined (i.e. IrriPasture).

- Be prepared for the season ahead:
  1. Do a system check- it pays so find the relevant check-list for your system from the project website.
  2. Do a soil moisture monitoring equipment check-this provides confidence in the data.
  3. Contact your energy provider and make sure your usage costs align with your irrigation scheduling plans. Check you power meter is accurate.
  4. Ensure you can monitor water use and costs by having a flow-meter.

- Watering right creates the right platform for strategic N use- if there is adequate soil moisture (>50%) and active plant growth, apply N.

- Start-up irrigation on time after the last rainfall event to create every opportunity to maximise plant growth- keep soil moisture in the RAW, or “sweet spot” for each soil/plant combination under irrigation. Rainfall + Strategic Irrigation= conditions for optimal plant growth.

USEFUL GLOSSARY

ET- Evapotranspiration provides a relatively objective and reliable estimate of the water requirements of actively growing plants in a farm situation. Evapotranspiration depends on a number of factors including sunlight, wind, temperature and humidity.

ETo – Reference Evapotranspiration specifically refers to the rate of evapotranspiration from a very actively growing, well-watered grass stand which is 120mm in height. In terms of its water use, this standard reference pasture stand provides a workable representation of good productive pastures across a well irrigated farm.

RAW – Readily Available Water to plants will vary depending on the soil and plant characteristics. Eg. for an established ryegrass pasture an assumed 40mm of RAW is used. This figure may vary somewhat for different paddocks or farms. It will be lower for newly established plants with a shallower root system and is likely to be higher for crops like lucerne or maize with a deeper root system. Knowing the RAW is fundamental for using soil moisture monitoring.

IrriPasture – a weather based scheduling and recording tool developed by the University of Southern Queensland, Centre for Engineering in Agriculture. You can use this tool on your PC or as an App.
Case Study 1
Opportunity loss - delayed response to monitoring & scheduling technologies

By Peter Smith (Sapphire Irrigation Consulting) & Marguerite White (ICD Project Services)

What were the opportunities to schedule irrigation more appropriately?

Using information entered into IrriPasture, irrigation was applied in September and October. The issue was not in starting too late but leaving the irrigation intervals too long between the 31st of October and the 12th of November, and again from about the 24th of November and the 14th of December. These two periods allowed the soil moisture to drop substantially at a time when the pasture water demand was rapidly increasing. There were several rainfall events during both of these periods, and given the weather forecasts at that time, the farmer was hopeful of more rain than he received and so, therefore, held back in applying irrigation.

The lack of water set the soil moisture below refill point (except from the 18th to the 25th of November), therefore retarding potential growth. Irrigation scheduling matched pasture water demand from the 15th of December for the rest of the season, but with only a few days exception, soil moisture remained below refill point. If the forecast of good rainfalls had eventuated, the soil moisture may have been in the Readily Available Water range and the pasture may have had sufficient water.

Lesson: irrigate using scheduling tools even in the early part of the season.

The soil moisture probe traces indicate that at about the 11th of November, water use was slowing and therefore affecting growth. This was only for a few days until the 14th of November when the root zone was refilled with irrigation.

This was repeated when from the 8th of December, water use was slowing until the 14th of December when it was refilled. As a generalisation the area of the paddock where the probe was located usually displayed a high crop coefficient value (Kc) relative to other areas of the paddock, so the water use indicated by the probe traces are highly likely better than the rest of the paddock area i.e. The probe provides an isolated indication of moisture levels whereas IrriPasture provides information across the entire pasture area.

Lesson: Use of both a soil moisture sensor set to indicate the depth irrigation water has moved to, and any one of the freely available weather based irrigation scheduling tools to indicate how much water has been used so that a general soil water balance record can be maintained. This combination is a good start for irrigating dairy farmers.
Case Study 1 continued

If irrigation had been applied during the abstained intervals, what would the additional costs have been?

An additional 40mm of water applied during each of the two long periods would have improved the situation. This equates to 5.4 ML each time, a total of 10.8 ML. Assuming $0.2488 per kWh (weighted average cost), and the pumping cost of $59.96 per ML, 10.8 ML would have cost $647.57 to pump. At $15.36 per ML, 10.8 ML would have cost $165.90. This is a total extra cost of $813.46.

Sapphire Irrigation Consulting Disclaimer: the figures from the SID for full and refill points are determined from literature based on soil texture only. Comments should be interpreted with a measure of due caution.

Source: Smarter Irrigation for Profit- NSW Optimised Dairy Irrigation Farm Project: Irrigation Season 2017/2018 Final Report, April 2018

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Case Study 2

Comparing installation of good quality soil moisture probe for $1,500 versus the alternative...

By Scott Woods, Agronomist, Hazell's Farm & Fertiliser, Tamworth

In the Autumn of 2016 leading out of a very dry and hot February/March and prior to soil moisture monitoring probes having been installed, sown Annual Ryegrass was lost due to irrigation not starting early enough.

- The economic value of this including seed, fertilizer, sprays, contractors and unsuccessful irrigation was in the vicinity of $300.00/ha lost
- Re-sowing added another $200.00/ha
- From this, time to first grazing was then set back creating extra work, stress and costs in having to use stored feed.
- 100 big square bales of hay at a cost of $8000.00 were also needed to bridge the gap.
- Conservatively, irrigation not commencing on time and at the right rate cost Limestone Park $21,000 which constituted 3.7% of income for the 15/16 financial year.

Full understanding of the cost implications and understanding of the effects of soil moisture deficit was not realised until SMM was in place during the 2016/2017 irrigation season. This information was presented to local farmers and service providers by at the May 2017 Open Day.

Source: Smarter Irrigation for Profit- NSW Optimised Dairy Irrigation Farm Project: Irrigation Season 2016/2017 Final Report, April 2018
Energy Efficiency

It’s a no brainer- irrigation systems need to be maintained and operated according to specification to optimise efficient use of water and energy.

Whilst irrigation system performance reports are often considered costly, the NSW dairy irrigation trials and demonstration have all proved that the ball-park cost of $2,500 can be recouped in energy savings alone within 3-6 months. There are also obvious savings from more efficient water use (i.e. ± re-calibration of panels) and increased production (i.e. improved distribution uniformity (DU) across the irrigated area).

Over the past five years, twelve system evaluations have been conducted. All highlighted unnecessary energy consumption resulting from inefficient pump performance and over pressurised systems.

Table 1 demonstrates the energy efficiencies which have been/ can potentially be gained by improving pump efficiency alone across NSW irrigation demonstration farms.

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<th>Table 1. Energy cost implications of improving pump efficiency</th>
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<td>Pump Efficiency (%)</td>
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*Seasonal water use based upon peak daily water use of a lucerne crop over the local summer period as water usage not measured to date. “Potential” is the pump efficiency as specified by the manufacturer. These project sites are ongoing. Note: Weighted average pumping costs based upon previous irrigation season kWh charges (no other charges or discounts applied) and apportioned to time of use (peak, shoulder & off-peak). $0.21878/ kWh Tamworth, $0.2488/ kWh Upper Hunter, %0.23278/kWh Lower Hunter/ Gloucester

Reduced energy use at Tamworth

There was an overall 38.6% decrease in energy use over one year to produce one tonne of MS. Energy costs constituted 3.66% of gross milk income for the 15/16 irrigation season, reducing to only 2.44% of gross income in the 16/17 irrigation season. In the same period energy provider charges were raised by 17% (Peak & Shoulder) and 14 % (Off-peak).

Potential energy savings at Lower Hunter 1 & 2

The Lower Hunter site was charged $12,866 for 59,000kWh in 2018 (excludes daily charges). This site has 3 centre pivots (2.3 & 4 span) all supplied by a single pump. Conservatively, a combined increased cost improvement of 16% has been calculated if specification pump efficiency is achieved (71%). This recommendation alone would achieve a $2,000 saving on energy costs.

Measure to manage

- Review electricity bills as a means of monitoring ongoing performance and efficiency of the irrigation equipment.
- Know your electricity & water consumption costs per tDM produced (ML/tDM & kWh/ tDM, $/ tDM) or per tMS if the total milking area is irrigated.

Thank-you to the current project demonstration farmers: Tom Middlebrook (Bowman Farm, Gloucester), Adam Forbes (Kywong Flat, Gloucester) & Matt Brett (Tocal Dairy, Tocal). This project is supported by funding from the Australian Government’s National Landcare Program and Local Land Services (Hunter).