Less water over more land

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- Climate change projections indicate that the future will see years of higher allocations again but there will be greater variability in high allocations and more frequent drought periods.
- It is anticipated that irrigators will become water limited rather than land limited, and this will affect current and historic management decision processes when planning an irrigated cropping program.
- Results from the research published in this article suggest that when water is limited optimal farm performance in irrigated systems may be achieved from sub-optimal paddock performance and 'spreading the water' over more land, if it is available.

Irrigators Australia-wide are currently confronted by the challenges of drought, increased climate variability and poor business profitability, driven by lack of irrigation water, low prices for traditional commodities and increased input costs (agrochemicals, fuel and fertilisers).

Riverina irrigators are no exception. In the last decade and a half, the face of irrigation farming in the region has changed with drastically reduced irrigation water allocations and high variability of supply, as illustrated in Figure 1. Climate change projections indicate that the future will see years of higher allocations again, but these will be interspersed with years of high allocation variability and more frequent drought periods.

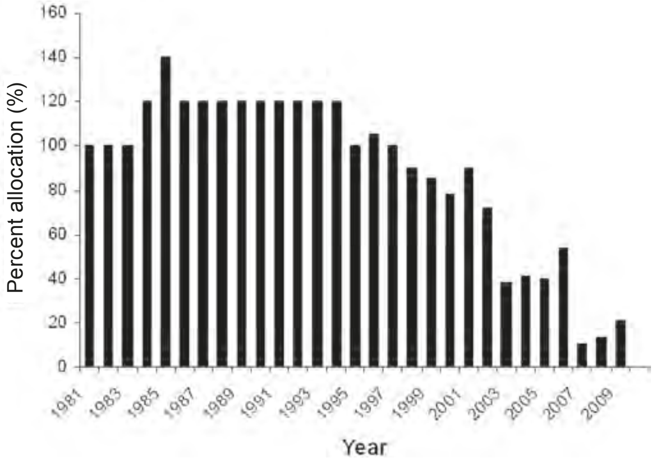

Figure 1. *Irrigation water allocations (percentage of licensed quota) for the Murrumbidgee Irrigation Area, for the seasons 1980–81 to 2009–10 seasons. The trend of 100% or higher allocation extends unbroken back to 1912.*

Riverina irrigation operations have shifted from being predominantly *land limited* to being predominantly *water limited*. This radical shift has resulted in increased pressure on farmers to achieve the greatest return per megalitre of irrigation water possible – and it will be particularly necessary in surviving low allocation years between good years in the future.

Adapting to forces of change

A research project investigating options for increasing the resilience of irrigated businesses which are adapting to external forces of change, has been funded by the National Program for Sustainable Irrigation (NPSI – formerly a program within Land & Water Australia), together with CSIRO, Industry & Investment NSW, Qld DEEDI and Ricegrowers' Association of Australia (RGA). The *forces of change* considered by the project include changing weather patterns, increased variability in irrigation allocations, and changes to water pricing structures, costs and commodity prices.

The project is titled *Increasing the Resilience of Eastern Australian Irrigated Farm Businesses*. It has two components: one focussed on the cotton districts from central Queensland to northern NSW, and the second focussed on the irrigated Riverina. The two components are led by Daniel Rodriguez from QDEEDI and Don Gaydon from CSIRO, respectively. The project started in July 2008 and is due to finish in July 2011.

The delayed permanent water rice trials, which are reported by Brian Dunn in this and previous editions of the IREC *Farmers' Newsletter*, are also part of the project.

The project operates by researchers and farmers working together, using case studies and simulation modeling to explore and evaluate new ideas and possibilities. In the Riverina, three case study farms are involved in the project, to represent a broad geographical range and a spectrum of farm types. These farms are located at:

- Gogeldrie – rice, barley, pulses
- Darlington Point – maize, wheat
- Barham – rice, wheat, pulse, lucerne.

At each of these operations, the farmers have been actively involved in testing the APSIM farming systems model and calibrating it for their own individual soil types, crop rotations and management practices. Then together with project researchers, they have been using the model to evaluate a range of practice-change ideas from the perspectives of production levels, risk and variability, and overall water productivity.

Understanding the nature of change

Adapting to changing external circumstances is nothing new for farmers. This has been a central tenant of farming since time immemorial. Our current situation represents a special challenge due to large changes in so many different aspects of the farm business. The options for changing farm practice can be described under two categories: *Incremental Change* and *Transformational Change*.

Incremental change

Incremental change includes things like reassessing basic agronomy – potentially changing crop mixes (species), varieties, rotations, planting dates, fertiliser regimes and irrigation regimes. This includes questioning and re-evaluating 'rules of thumb' which have applied in the past. For example, if the future is to be warmer, do the current mainstream varieties and accepted optimal sowing dates still apply? If not, how do they change?

Irrigation farmers must also learn and implement practices of dryland Australian farmers (stubble retention, fallowing), because in the future they are unlikely to remain purely irrigated businesses, as many have in the past. This is incremental change – nothing drastic, just incrementally fine-tuning operations to better match current and future conditions. Similarly, buying-up more land would be considered an incremental change – it is likely that economies of scale will help to remain viable in a future with a more variable supply of irrigation water and a hotter climate.

Transformational change

Conversely, transformational change would include adaptations like selling water rights to government and going totally dryland. Or, if soil types were suitable, investing in high-efficiency irrigation equipment (drippers, lateral moves) and targeting higher value crops such as vegetables. Another transformational change could be to relocate all or part of the farming operation to a different locality with more reliable water supplies – for example rice growing in northern Australia.

In the space available for this article, we present some analyses conducted on **incremental changes** to irrigation strategies for two of the project's case study farms.

From land limited to water limited production

In the past (prior to mid 1990s) irrigation water was always abundant in the Riverina and it was a 'no brainer' that farmers should target maximum production from individual paddocks by watering and fertilising to reach varietal potential. In that environment, the only way for farmers to increase their farm production would be to gain access to more land – they were *land limited*.

In recent years growers have been *water limited* – they often have excess under-utilised land and could easily increase their production if they had more irrigation water. So, an obvious question arises – how should I best use my available irrigation water over my abundant land? This leads to more questions.

- Should I continue to focus on achieving varietal potential in sown paddocks and plant a limited area of the farm?
- Should I spread this water more widely, and partially-irrigate a larger proportion of my abundant land?
- Which results in the best returns?
- Which presents the greatest risk?

Project officer Don Gaydon (CSIRO) and case study farmer David Cattanach (Darlington Point) discuss farm management options for irrigating with less water.

Answers based on real examples

To consider this question, we examined several scenarios or adaptation options on two case study farms. Descriptions of current practices and possible scenarios for 50% water allocations are presented in Tables 1 and 2.

Table 1. Adaptation options considered for the Gogeldrie farm, in response to an irrigation allocation of 50% licensed quota.

Case study 1 – Gogeldrie	
Current stats	600 ha 1783 ML licensed allocation Irrigated barley, soybeans, rice
Simulation	53 years production using APSIM model and historic climate data, assuming annual allocation of 50%
Historical management	barley-soybean rotation fully irrigated, clear all stubbles barley = 155 ha; soybeans = 66 ha
Adaption 1	increase barley row spacing from 220-400 mm retain barley stubble through soybean barley area = 162 ha; soybean area = 73 ha
Adaption 2	as per Adaptation 1 but reduce inputs on barley (aim for 3 t/ha crop rather than 6 t/ha) more water available for soybean barley area = 264 ha; soybean area = 86 ha
Adaption 3	as per Adaptation 2 but rainfall-based sowing rule for barley rather than 'watering-up' barley area = 358 ha; soybean area = 91 ha

Table 2. Adaptation options considered for the Darlington Point farm, in response to an irrigation allocation of 50% licensed quota

Case study 2 – Darlington Point	
Curent stats	400 ha cropping area 1700 ML licensed allocation Irrigated maize and wheat
Simulation	53 years production using APSIM model and historic climate data, assuming annual allocation of 50%
Historical management	maize-wheat rotation clear all stubbles fully irrigated, fully fertilised wheat = 175 ha; maize = 100 ha
Adaption 1	mulch maize stubble at end of wheat crop, tyne wheat stubble fully irrigate and fertilise wheat = 175 ha; maize = 100 ha
Adaption 2	increase winter crop proportion mulch maize stubble at end of wheat crop, incorporate wheat stubble fully irrigate and fertilise wheat = 300 ha; maize = 50 ha
Adaption 3	lower inputs on winter crop, increase summer area wheat fertiliser from 200 to 100 kg/ha nitrosol 2813 water on a 120 mm soil water deficit rather than a 70 mm deficit wheat = 175 ha, maize = 135 ha

The first adaptation option considered on each property was to simply retain more crop residues than normal, as a means of minimising soil evaporation and reducing irrigation requirements. Modeling and farmer experience indicated that it would be possible to save a single irrigation in many seasons by doing this, hence we factored in the water saving and recalculated the potential farm area which could be sown. We then undertook the same process with the other adaptation options listed, each time using reductions in water use on individual paddocks to allow the sowing of a greater overall irrigated area.

Case study 1 – Gogeldrie

The performance of the Gogeldrie operation under the various adaptation options is shown in Figures 2 and 3.

All the adaptations considered (apart from the residue retention) resulted in reduced gross margins at the paddock scale (Figure 2). This was not unexpected – if you reduce the inputs (water and fertiliser) to a crop and aim for a lower yield (Adaptations 2 and 3), you would expect to reduce your returns from that paddock.

However the big difference came in whole farm performance, shown in Figure 3. Even though individual paddock gross margins were reduced, the whole farm returns were increased in most years, due to the greater area planted. Of note was the increased risk profile – in years when the winter rainfall did not deliver assistance, the grower was left with a large area of poor yielding crop. Using historical weather data for these simulations indicates that the grower would come out in front in more years than not, resulting in a greater average farm performance over the longer term. It would be a matter for the individual farmer to decide whether this risk profile was acceptable.

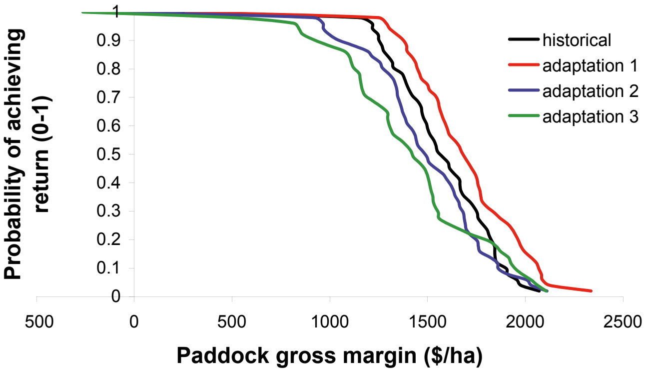

Figure 2. Paddock scale gross margins for the adaptation options considered on the Gogeldrie farm.

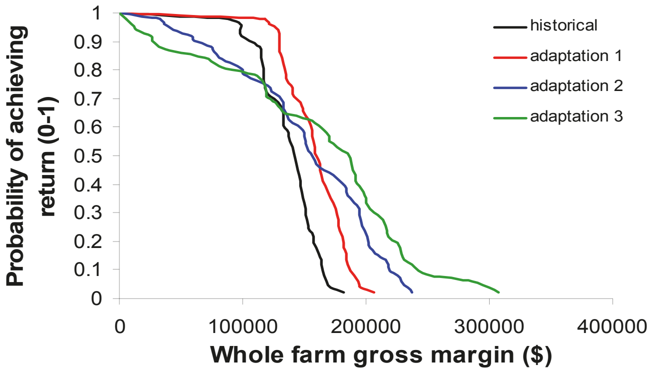

Figure 3. Whole farm gross margins for the adaptation options considered on the Gogeldrie farm.

Case study 2 – Darlington Point

In the second case study on the Darlington Point farm, Figure 4 shows that whole farm advantages from reducing inputs on the winter crop were not seen (Adaptation 3), however some gains were evident from shifting the operation focus from summer crop to winter crop (Adaptation 2).

Additionally, it may be possible that certain crops (for example, barley at the Gogeldrie farm) provide a better response to reduced inputs than others (wheat at the Darlington Point farm), however this is the subject of further investigations.

For both case study farms, maintenance of crop residues through subsequent crops resulted in reduced irrigation water demand, and hence improved gross margins at both paddock and farm scale.

Handling the variability

The broadacre irrigation industry will be faced with years of good production and years of limited production, depending on the variability of weather patterns and their consequent impact on water allocations. The big challenges for Riverina irrigators in the future will be handling this variability and making the best use of water and staying viable in the low allocation years.

When production is water limited, growers should not always assume maximising production from individual paddocks is the best option. Optimal farm performance in irrigated systems will often be achieved from sub-optimal paddock performance and 'spreading the water' when available land is in abundance.

Inherent flexibility will still be critical, because of changing commodity prices and cost structures, hence optimal crop mixes and irrigation and fertiliser strategies will vary. As the case studies presented indicate, what works well for one farm may not necessarily be the best option for a farm with a different set of constraints.

The future of the project

Between now and July 2011, the project team will continue to analyse a range of adaptation ideas for using limited irrigation water. They will extend current analyses to consider a range of different water allocation scenarios, water prices, input costs, commodity prices and climate change scenarios, to try to understand how best to utilise a highly variable future resource in a range of different circumstances. It is important to note that the results presented thus far are preliminary and aimed to give readers an idea of the scope of project investigations, rather than be final results.

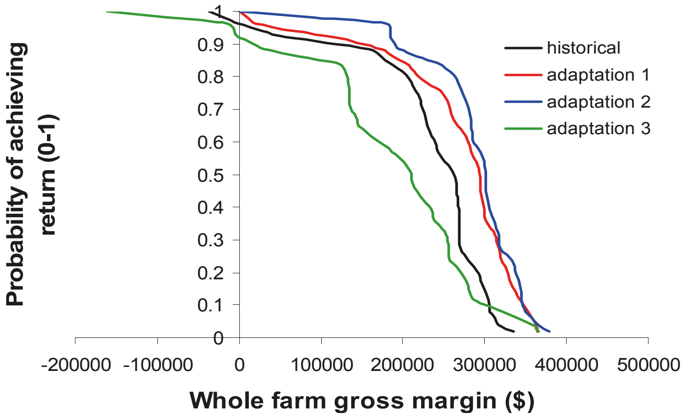

Figure 4. Whole farm gross margins for the adaptation options considered on the Darlington Point farm.

The case study examples presented in this paper illustrate that certain adaptation options may be useful to some farms and not to others, depending on such factors as target crops, area available, labour and equipment constraints, and attitude towards risk. The project team aims to simplify the learnings gained from these complex analyses and make them available to growers in a digestible fashion. An aim is to gain an understanding of simple 'rules of thumb' regarding distribution of irrigation water, and how it may apply to different operation types.

In the coming year, there will be a number of workshops in regional centres where information will be presented and feedback sought to further refine analyses. The project team will also begin a new phase of the project, aiming to make modeled information available for growers to consider when deciding under what circumstances it makes sense to sell water, and when it makes sense to use the water on farm.

Further information

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Further reading

CSIRO Murray Darling Basin Sustainable Yields Project at www.csiro.au/partnerships/MDBSY.html

Last season's maize stubble at the Darlington Point case study farm, clearly showing the soil moisture preserved underneath.