

FACT SHEET

Increasing the resilience of Eastern Australian irrigated farm businesses

What is the issue?

Australian irrigators are under increasing pressure to maintain the viability of their farm businesses in the face of reduced surface and ground-water allocations; increasing competition from alternative users (such as urban, industry and the environment); the cost-price squeeze; and the uncertainties in climate change. The key challenge to irrigation growers is then **how to identify practical and actionable strategies that increase returns per ML of water available at the whole farm level while at the same time reducing or minimizing risks.**

Here we report the experiences of a team of farming systems that used experimental and participatory modelling methods to explore farmer's opportunities to develop more profitable and less risky irrigated cotton-grains and rice-grains farm businesses.

What did we do?

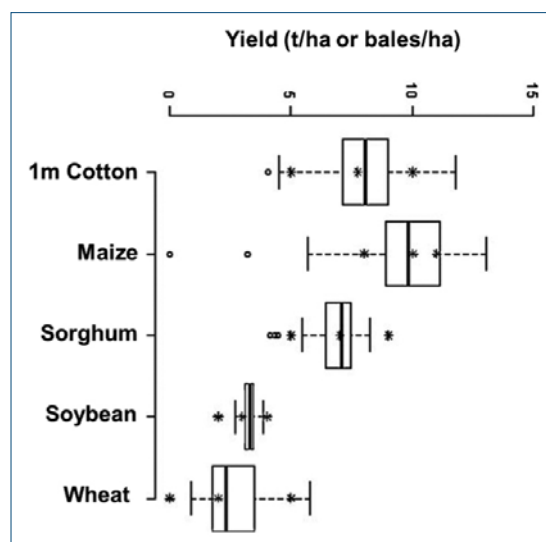
We basically did three things:

First we engaged collaborating farmers to help us identify and understand their issues, constraints, and opportunities for improvement. We involved rice-grain growers from the Riverina region in Victoria and New South Wales, and grain-cotton growers from northern New South Wales, southern and central Queensland (read about our case study farms at www.irrigatedcropping.blogspot.com).

Second, in close collaboration with these farmers we developed whole farm modelling tools capable of realistically representing farm assets, management strategies and practices in a computer. To achieve this we needed to describe and understand our farmers' businesses, so we discussed "What do they do on their farms?, How they do it?, and Why they do it?".

After a number of interviews and discussions where modelling results were presented, our farmers were confident that the model was able to represent their farm business (Figure 1) and that it was a good tool to explore a range of *What if?* questions in terms of their practices, tactics and strategies.

Figure 1



Validating the models with farmers. The asterisks in Figure 1 show expected yields from one of our farmer's (Dalby) i.e. according to their experience, their minimum, most likely, and maximum yields. The boxplots show the yields predicted by the APSFarm model. In general the farmer's most likely yield coincided with the most likely yield simulated by the model. This gave this farmer confidence that the model could be used to further explore his farming system.

Third: we used this new model to research their questions and ideas on how to improve the profitability of their farm business, or how to achieve particular objectives of their interest e.g. use less water, improve soil health, etc.

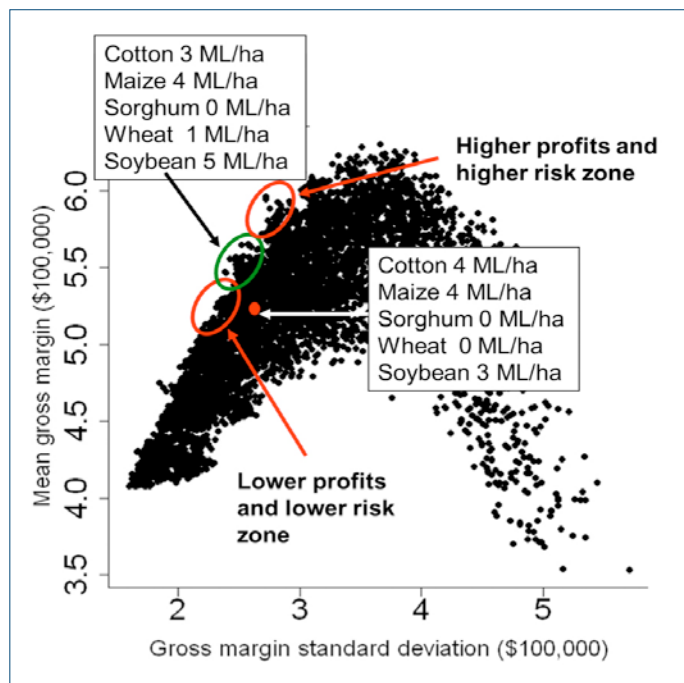
The computer-generated information was then used to inform discussions with farmers, where the model results were contrasted with farmers' expectations. The whole aim of the exercise was to help farmers' gain new "experiential" knowledge of the implications of alternative decisions in the use of their assets, so they would feel more confident with their decision or gave them new ideas to explore and practice in their farms.

What did we find?

With our grain-cotton farmers from the Darling Downs we found out that by changing the allocation of irrigation water and land area between different crops farm profits and risks could be increased by up to 10% without increasing economic risks (Figure 2).

Simulating farms and farmers. Using the APSFarm simulation model we calculated the impact of varying the allocation of irrigation water across alternative crops. This information was then used in discussions with farmers. For example using farmer's expected prices and water allocations, Figure 2 shows the relationship between the simulated average whole farm gross margin (per year) and a measure of its variability (standard deviation) for an irrigated farm from Dalby, Qld. The red dot represents the present performance of the farm, which is achieved by reserving the following amounts of water at sowing: 4ML/ha for cotton and maize crops, 3ML/ha for soybean, and none for wheat and sorghum. The black dots represent the outcome of alternative allocations of water to those crops. When this graph was shown to our farmers they immediately identified that the present management of the farm could be improved in a number of ways. The farmer could increase profits at the expense of higher risks, or reducing risks while keeping the same level of profits (shown by the two red circles, respectively). Though more interesting to our farmer was the idea that by slightly changing the allocation of irrigation water he could on average make another \$30,000 per year without increasing his risk (green circle). In general terms this change would involve slightly reducing the allocation of water to cotton while increasing the allocation to soybean and wheat crops (top text box).

Figure 2

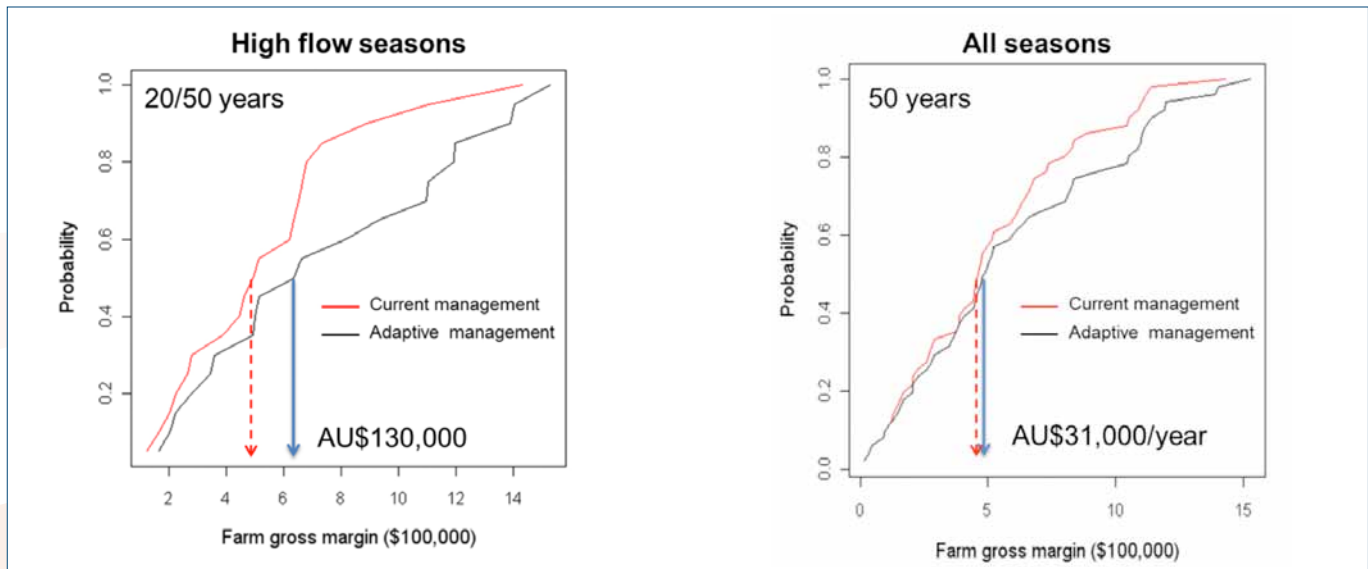


Clearly variability in water allocations and commodity prices will affect the results in Figure 2. So, our farmers were interested to know if additional information from a seasonal or river flow forecast could help them make better informed decisions. For example for the case study farm in Dalby, the area planted to cotton each year depends on the amount of stored water available for irrigation at the time of sowing. To answer this question we used an NINO3 index (<http://amath.colorado.edu/courses/2460/2004Spr/Lab1/nino3.html>) that has a reasonable ability (F test p-value = 0.03) to predict the relative size of summer Condamine River flows. The NINO3 predictions of river flows was used to set up an adaptive management strategy that adjusts the amounts of stored water required at sowing for each hectare of cotton being considered for planting. When a higher river flow than normal was expected less stored water at sowing per hectare of cotton was required due to the increased probability of both additional river flows and in-crop rainfall. This then allows for a greater area of cotton to be sown for that season. Similarly, when a relatively lower river flow is expected for the season, then more stored water per hectare of cotton is required and the area sown is reduced.

We found that the predictive capacity of NINO3 was particular high for the prediction of high flow seasons, justifying its use as a predictor of stream flow. In those years when the forecast is available and incorporated into farmer's sowing rules, we estimated that farmer's returns could increase by up to \$130,000 (Figure 3).



Figure 3



Making water allocation rules based on a river flow forecasting system. Figure 3 shows the differences between current farmer's management (red line), and an adaptive management (black line) for those seasons when a NINO3 based prediction of either high or low flow was available, i.e. 20 out of 50 years, a); and b) for all the years between 1958 and 2009. This shows that the development and use of river flow forecasting tool for the Condamine River could increase farm profits at Dalby. The most likely benefits (median) were \$130,000/year when only considering the high flow seasons, and \$31,000/year when all years (50) are taken into account. The graph also shows that the adaptive management strategy would work particularly better during the high flow

seasons. Feedback from some case study irrigators was initially skeptical that a seasonal prediction would be useful. However after the results were presented they agreed that there is value in a seasonal forecast provided it was available in sufficient number of seasons.

For the case of Riverina rice-grains growers spreading the available water and supplementary irrigating winter cereals in years of low allocations, can increase farm profits. Some of the water-spreading strategies offered up to 90% improvement in farm returns over traditional practices, but up to 30% worse performance in years of high irrigation levels.

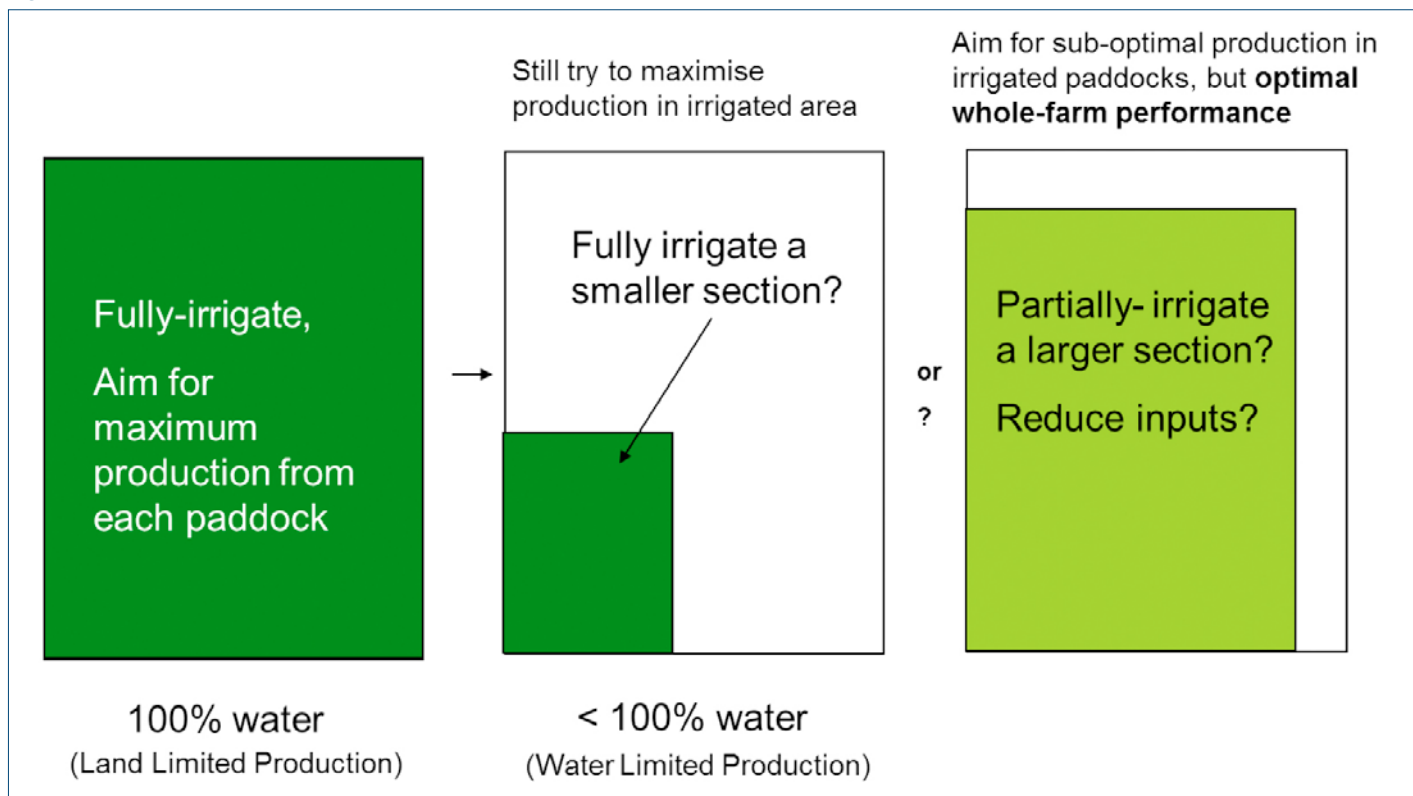


Daniel Rodriguez demonstrating the Irrigation Optimiser (<http://www.apsim.info/irrigationoptimiser/>)



Peter deVoil and Brendan Power inspecting the irrigation infrastructure in St George at Kia-Ora with manager Hugh Mckay.

Figure 4



Making water last. Figure 4 shows a schematic representation of Riverina farmer's options in seasons of lower than 100% water availability. As indicated by our participating farmers "Before this research, the benefits of water spreading during low allocation seasons were just 'gut' feelings..." "... These research has played a valuable role in confirming the value of these practices.." which is an important first stage in the adoption of a new technology. Specifically, when water allocations are low, farmers like Barry Kirkup and Rob Houghton will 'spread the water' and aim for sub-optimal yields in winter cereals, concentrating on sowing more land area and maximising water productivity for the farm. Alternatively, when water is abundant they will crank everything up and go for maximum crop yields to maximise water productivity.

We also found that maximising long-term average farm returns requires irrigation and management strategies which vary on a season-by-season basis based on allocations. Delaying permanent water irrigation in rice provided an 8-17% increase in water productivity resulting in either a similar percentage increase in rice production for the same amount for water, or more available water for other cereal (wheat, barley) irrigation.

We also developed a framework on which on-farm and off-farm water exploitation options (for example, irrigating and growing crops, compared with sale of allocation or entitlement on the open market) could be compared based on their risk-return characteristics. This framework uses Modern Portfolio Theory – a method widely used in the financial world to compare various share options, newly adapted by us for use in irrigated agriculture comparisons.





So, what does it all mean?

For all our case study farms we could jointly identify and quantify strategies that would allow them to improve returns without increasing risk. In some cases our results confirmed farmer's intuitive expectations. Farmer's response to this new information varied, though a key learning was a better understanding the trade-offs between potential gains in profits at the cost of taking a little extra risk.

Clearly for farmers on river entitlements, the value of seasonal stream flow forecasts (www.bom.gov.au/water/ssf) was a positive surprise.

Though further work would be required to develop the required tools to fully integrate and capture the value of this additional information on the management of irrigated farms across eastern Australia.

Acknowledgement

This project was co funded by the National Program for Sustainable Irrigation (NPSI) and the Grains Research and Development Corporation (GRDC).



GRDC
Grains
Research &
Development
Corporation

Your GRDC working with you

Daniel Rodriguez¹, Don Gaydon², Brendan Power³ and Peter deVoil³

¹ Queensland Alliance for Agriculture and Food Innovation (QAAFI),
The University of Queensland, Toowoomba, Qld 4350 email: d.rodriguez@uq.edu.au

² CSIRO Ecosystems Sciences, Brisbane Qld email: don.gaydon@csiro.au

³ Agri-Sciences, Toowoomba Qld brendan.power@deedi.qld.gov.au, peter.devoil@deedi.qld.gov.au

Guy Roth, Program Coordinator

0417 223 179

guyroth@roth.net.au