Agronomic advice in a variable climate; chess, poker or the pokies?

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Abstract
The variable and erratic climate is an ongoing challenge for grain farming in Australia. Awareness of some of the drivers of climate variability such as El Nino Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) is increasing, but communicating and applying probabilistic seasonal climate forecasts to decision making continues to be difficult.

This short paper is a reflection based on 1) an overview of agronomic written advice provided in GRDC updates, fact sheets and Ground Cover articles and 2) workshops on climate risk held in July and November 2018 with 20 early to mid-career agronomists from the southern grains region. We found that most agronomic advice is like chess where there is always an optimum move determined by skill. Climate risk is acknowledged, but it is often treated more like the pokies (random chance) than poker where decision outcomes are due to skill and chance. There are many reasons that probabilistic seasonal climate forecasts are hard to use, one of them might be because we provide advice for chess not poker.
Key words
Climate variability, Decision making, Seasonal climate forecasts

Background
Climate variability reduces farm profit directly through difficult seasons and indirectly by creating risky decisions. Drought, late starts, frost and heat have obvious direct impacts on farm profitability. The fortunes of grain farms and the communities that support them rise and fall with the seasons. A good season like 2016 in the southern grains belt allowed many people to pay down debts, invest in equipment and human capital whereas difficult seasons like 2017 and 2018 obviously lead to reduced profits and less investments. Because the coming season is uncertain, many farmers will make the reasonable decision to apply lower rates of fertiliser, perhaps sow later in frost prone regions and grow less pulses and canola than is optimal for their long term productivity. These decisions are rational, but they do create a drag on long term farm profit and contribute to yield gaps (Sadras et al. 2018). The GRDC 2018–23 RD&E plan emphasised both profit and risk *"Risk is an important part of the profit equation. Risk management that is too conservative can limit profit in above average production years while approaches that are too aggressive can expose the grower to equity issues that adversely impact profit and future operations."*

Chess vs Poker
Although grain growing presents classic examples of risky decisions, all decisions involve prediction and judgement. Duke (2018) describes a conversation between Jacob Bronowski (The Ascent of Man) and John van Neuman (Manhattan Project and creator of Game Theory) about whether decision making was more like chess or poker. Chess contains no hidden information, the pieces and positions are there for both players to see, there is no roll of the dice that can make a bishop disappear. Losing at chess is not bad luck, it can always be traced to the wrong moves. Poker, by contrast, is a game of incomplete information, of decision making under uncertainty. Losing a hand of poker may well be bad luck, yet there is skill involved as indicated by champion poker players (van Loon et al., 2015).

Most of the advice and take home messages written by researchers and advisers for grain farmers is closer to chess than poker. The best examples break a complicated problem down to a series of steps where the outcome is more or less guaranteed. This practical step by step approach has made an enormous contribution to sound agronomy. A careful reading of advice for farmers suffering in the later part of the Millennium drought (GRDC 2008) shows that all the recommendations are farm business and agronomy practices that are good to do whatever the coming season. Recommended actions include developing an annual business plan, identifying the better and poorer paddocks, conducting a feed budget for livestock, controlling summer weeds, considering fertiliser costs, carefully monitoring crops and pastures and planning marketing strategies. That is not to say the outcome or benefit of following this advice is not affected by climate. For

example, the benefit of no till and controlling summer weeds will be more apparent in poor seasons. Although the *outcome* is sensitive to climate, uncertainty about the coming climate doesn't change the advice or decision. These are not *climate sensitive decisions* like choosing the appropriate rate of N topdressing. Table 1 compares farm management practices that deal with climate variability, the first column is more like advising a chess player, the second column more like poker.

Table 1. Comparison of two farm management practices; maintain crop residue (Good to do whatever the season - chess typology) vs N top dressing (depends on the season - poker typology).

	Farm management practice relatively **insensitive to seasonal climate.** *"Good to do whatever the season".*	Farm management practice **sensitive to climate of coming season.** *"Best choice depends on how season turns out"*
Example for illustration	Maintain crop residue to improve WUE, reduce erosion risk and tillage costs.	Topdressing nitrogen at a rate higher than crop demand in an average to poor season
Chess or Poker?	**More like chess** – a series of logical steps leads to improved WUE. Decision closely linked to outcome with little hidden information.	**More like poker** – harder to distinguish a lucky decision from a good decision. Key information is hidden at time of decision.
Is this part of managing climate risk?	Yes, conservation farming is a major way that farmers manage climate risk.	Yes, matching inputs to the season is an important part of managing climate risk.
Does the *outcome* of the decision vary depending on the coming climate?	Yes, somewhat – although there are benefits of stubble retention in all years, the relative gains are greatest in dry years.	Yes, outcome strongly related to season – extra nitrogen will be a better investment in average to good seasons.
Is the *optimum decision* sensitive to the coming climate? Will there be regret?	No, decision is relatively insensitive to climate. Whatever the climate, regret about the decision will be low.	Yes, decision is highly sensitive to climate. Regret arises from either increased downside risk if drier than average or missed opportunity if wetter than average.
Value of historical climate for that location	Long term climate data might be useful to analyse long term benefit.	Helpful to work out risk and return over long term and before using a seasonal climate forecast.
Interest in seasonal climate forecast (SCF)	Little value of SCF because it is "good to do whatever happens."	Potentially high value because "outcome depends on how season turns out.
Does climate uncertainty make the decision difficult	No, decision is not especially difficult. Practical application can be challenging.	Yes, would be an easy decision to decide on input level if there was no climate risk (eg. irrigated crop).
Nature of decision	A more strategic rule that applies across many seasons.	A tactical response to the coming season.
Ease of giving advice	Adviser needs to tailor advice for individual client finance, soil type etc. But an experienced adviser can be confident that procedure will work.	The uncertain season means that outcomes only partly correlate with the decision. Will be harder to distinguish good advice from bad advice.
Ease of measuring success of advice and decision.	Relatively straightforward to measure extra stored soil water and subsequent benefit in crop yield.	Will require a number of years results to confirm good as opposed to lucky/unlucky advice and decision.
Some other examples	Most sound agronomy; summer weed control, timely sowing, matching variety to sow date and maintaining good rotations. Business management including diversification both on farm (livestock and crops) and off farm. Use of income smoothing such as FMD.	Crop choice, area of cropping vs livestock, area dry sown in delayed start. Whole farm examples include major purchase that have cash-flow implications or the decision to self-insure or purchase insurance, decisions about harvesting capacity.

With the notable exception of Yield Prophet (Hochman et al. 2009) even a problem like the appropriate N fertiliser rate in dryland farming tends to be written about as a chess move. Most of the discussion on N budgeting emphasises calculating the supply of N by soil testing and estimating mineralisation and then determining the crop demand by picking a single decile or target yield. There is often an acknowledgement

that information on the coming season is unknown. However, there is little formal, practical, step by step guidance on how to consider this uncertainty. Much of the key material on N budgeting could be applied to an irrigated grain crop in the same way as a dryland crop. Taking the chess vs poker analogy further, there is a spectrum between chess (pure skill), poker (skill and chance) and pokies (pure chance). Much of what is written as advice (including by the senior author) can be seen as chess advice with a reference to pokies.

Workshop on climate risk with agronomists

A group of about twenty early to mid-career agronomists from the GRDC Southern Region (Tasmania, Victoria and SA) representing private and reseller agronomists were funded to attend workshops in Adelaide in July and November 2018. The workshop covered climate science with experts from the Bureau of Meteorology and Agriculture Victoria but the main emphasis was on using probabilistic forecasts in grain farm decision making. The small sample size (19 in July and 18 in November) limits how much can be interpreted from the data. Nevertheless, Figure 1 shows increased self-assessed levels of confidence over the year, especially in the understanding of climate drivers and where to access information.

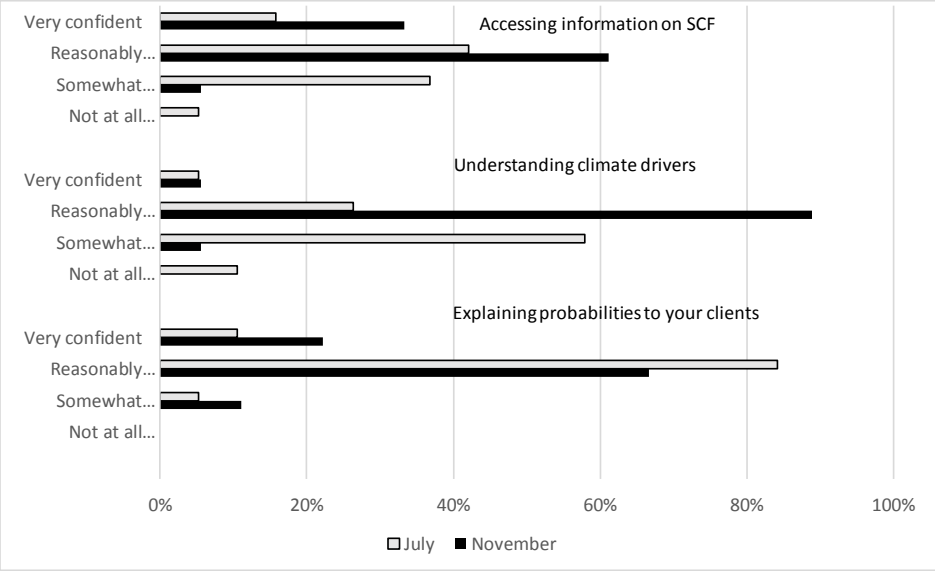

Figure 1. Self assessed confidence in where to access climate information, understanding climate drivers and using probabilistic forecasts. The same questions were asked prior to the workshops (July 2018, n=19) and post workshops (November 2018, n=18). Note that 1 participant = 6% for July and 5% for November.

We developed an Excel based framework called Rapid Climate Decision Analysis to compare the outcomes across deciles of growing season rainfall of a higher risk and return choice (eg. a higher N rate or a pulse crop) with a more conservative lower risk and return choice (lower N or a cereal). The key feature is that rather than budgeting for a single outcome (often decile 5) users are stepped through a process to provide information for three to five season types and presented with an interpolated graph that covers outcomes across all deciles. The representation of advisers' knowledge as profit by deciles provides a rich source of information on climate risk. The mental switch is to compare the profit of two decisions across states of climate (in this case deciles of growing season rainfall) with careful attention to where the lines cross over (if at all) and the relative size of the downside risk and the upside missed opportunity. A common request is for climate science to indicate which decile is most likely, but a better representation of the forecast is a shift in the likelihood of different deciles. If a seasonal climate forecast is represented as a revised climatology, this revision can be superimposed on the decile by profit graph which allows a new comparison of the two options.

The salient point for this paper, is the mixed reception amongst the 18 agronomists to the simple framework. This contrasted with the overwhelmingly positive feedback to discussion on climate drivers rather than discussing how to apply the information. It was encouraging that 10 of the 18 indicated that they would use the tool in their work and some of the feedback was highly positive. At the same time three indicated they wouldn't use it and five were unsure. Discussion during the workshops indicated that none of the agronomists were suggesting alternatives to numerical approaches to climate risky decisions. Rather they

referred to the complexity of the decisions, the uniqueness of each client and how they used an intuition about the coming season that might be influenced by talk of an El Nino or a general sense of how the year was shaping up.

Conclusion: Numerical vs weighted intuition for agronomic advice in climate sensitive decisions
Frameworks such as Rapid Climate Decision Analysis are not designed for routine decision making. The more modest role is as a tool to think, discuss, confirm or start arguments about rules of thumb on climate risk in the grains industry. We subtitled the framework "fast graphs for slow thinking" as a reference to Khaneman (2011). The graphs can be generated relatively quickly because grain growers and agronomists have a deep understanding of production risk and how this production changes across deciles of growing season rainfall.

There are many reasons that agronomists, like most humans, use the fast thinking of intuition rather than slower analysis in decision making. Three related reasons are as follows; Fast and frugal decisions free up scarce time and headspace for other aspects of business and personal life. Second, worrying about uncertainty can be unproductive, a sense of confidence and control has many advantages for well-being, social standing and business success. Third, the real messy world of decision making on grain farms is too complicated (lots of numerical components) and complex (involving humans) to solve with numerical analysis. According to Khaneman (2011), some of the efficiency of fast thinking is the quick creation of a coherent, plausible narrative. "*The measure of success for* [fast thinking] *is the coherence of the story it manages to create…. When information is scarce, which is a common occurrence,* [fast thinking] *operates as a machine for jumping to conclusions."* It is more efficient to think about a single narrative or outcome (decile 5); if pressed it is possible to jump to thinking what the outcome will be if it is decile 3 or decile 7. Comparing the outcomes of decisions across a range of possible futures is mentally demanding for most of us but relatively easy in a spreadsheet. Adjusting this suite of outcomes with a probabilistic forecast is a mental puzzle. It is especially difficult to avoid over or under emphasis of the new information. However the correct revision of deciles is straightforward in a spreadsheet and people easily recognise patterns of shifts in graphs, especially if they were involved in providing the underlying information.

As Duke (2018) points out, whether playing poker or making a business decision, the first step is to say *"I'm not sure"* but this is not the same as *"I know nothing"*. Champion poker players are continually adjusting probabilities and recognise that each decision has a range of possible outcomes, some more likely than others. The farming game involves a bit of chess and a bit of poker but most climate risk decisions are more like poker. When providing advice in a variable climate, taking time and slowing down is likely to improve the process of decision making. This involves pulling together the best information available at the time, thinking through possible outcomes. In parts of the country and times of the year when there are skilful forecasts the probabilities can be adjusted with seasonal forecasts which may or may not change the decision.

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