Determining critical farm management decision points to improve agro-meteorology research and extension; an example of utilisation of seasonal climate forecasts in farm decision making

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Abstract

Australian farms are both exposed and sensitive to climate variability and change. There is a general perception that seasonal climate forecasts are currently underutilised in Australian farm business management, and that greater consideration of seasonal climate forecasts by the rural sector could help quantify potential risk and opportunity better to assist with more optimal resource allocation leading to greater profits. In the past, Australian farmers have been upskilled to increase their understanding of the climatic system, variability within this system and providing guidance in interpreting seasonal climate forecasts. This presumption may, unintentionally, restrict interpretation of the value of seasonal climate forecasts in experimental designs. A subtle, but meaningful, alternative is to provide prominence to decision frameworks of which seasonal climate forecasts is a potential contributor. Through the development of this methodology using a southern beef cattle case study, it is apparent that the number of key decisions points sensitive to seasonal climate forecasts are relatively few and the decision environment is complicated by a number of other drivers which have precedence over seasonal climate forecasts. This targeted and considered elicitation has provided key foundational information for biophysical and economical modelling, providing greater confidence the results of the valuing of seasonal climate forecasts will be more appropriately represented within the management decision environment.

Keywords

Climate variability, qualitative assessments, beef management, decision framework, decision tree.

Introduction

Australian farms are both exposed and sensitive to climate variability and change. Robust farming systems have evolved in this changing and challenging operating environment with their resilience tested and systems refined over time. There is a general perception that seasonal climate forecasts are currently underutilised in Australian farm business management, and that greater consideration of seasonal climate forecasts by the rural sector could help quantify potential risk and opportunity better to assist with more optimal resource allocation leading to greater profits (CIE 2014).

Within each farming system, the manager makes key decisions in relation to farm business resource allocation in order to meet the business objectives whilst balancing risk against potential return. Such decisions are made within the context of information which could be best classified as either, ‘known’ or as ‘forecasts’ of future conditions, typically market and seasonal conditions. It is the skill of management to appropriately weight such information and subsequently use this knowledge to decide on an effective course of action. Management must consider the downstream impact of a decision made at a point in time into the future and the potential ramifications, as there is often flow-on effects. Given the complexity of the farm decision environment, any assessment of the value or usefulness of seasonal forecasting within a farm management system must be representative of industry specific decision making environments.

In the past, Australian farmers have been upskilled to increase their understanding of the climatic system, variability within this system and providing guidance in interpreting seasonal climate forecasts (Darren Bayley personal communication). These sessions and subsequent provision of more targeted information, although helpful and often well received; establish seasonal climate forecasts as the prominent information in decision making. This presumption may, unintentionally, restrict interpretation of the value of seasonal climate forecasts in experimental designs. A subtle, but meaningful, alternative is to provide prominence to decision frameworks of which seasonal climate forecasts a potential contributor.

This paper describes a method to elicit relevant decision points from farming systems and to further test the sensitivity of identified decision points to different drivers, both known and forecasts. Beef production in southern Australia was used a case study to demonstrate the methodology. This elicitation process provides the foundation for more detailed analyses including investigating productivity and profitability gains from including forecast information into management decisions.

Methods

The broad methodology undertaken was to:

1. identify key management decisions which were potentially sensitive to seasonal climate forecasts;
2. identify the key drivers of the decision, this includes both antecedent and forecast conditions including but not limited to seasonal climatic outlooks; and
3. to understand the relative sensitivities of these drivers.

This process is detailed using a case study for southern Australian beef.

The southern beef case study involved staging a small targeted one day workshop in Wagga Wagga in southern NSW in July 2016. The invited participants were targeted based on their reputation within and knowledge of the sector and with remuneration provided upon request. Representation at the workshop included; members of the Southern Australian Meat Research Council's (SAMRC) southern regional committee, experienced experts from Charles Sturt University's Agricultural Faculty and the NSW Department of Primary Industries. Many of the participants owned and operated their own beef enterprises and represented the beef industry on various industry bodies demonstrating their positon and regard within industry.

After initial workshop overviews, the participants were briefly provided information regarding seasonal climate forecasts. In order to avoid potential bias from participant perception of existing forecast products participants were encouraged to see the 'forecast' as both skilful but probabilistic being represented as a tercile forecast with a chance of conditions either being in tercile one, two or three. In the average state represented in **Error! Reference source not found.** there is an equal chance of conditions being experienced in any of the represented three tercile groupings. It should be noted that interpreting forecasts was not the aim of the workshop; rather it was to gain an understanding of how forecasts could influence decision points. As such, participants were free to identify when, where and in what form that the seasonal climate forecast should be to inform decision making to provide an economic boost to the sector.

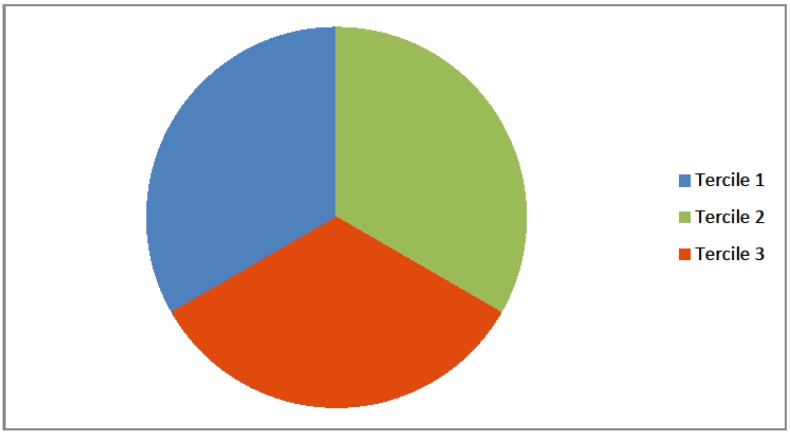

Figure 1. Theoretical representation of seasonal rainfall forecast style used in the southern beef workshop.

In order to elicit the relevant information, a representative case study for the high rainfall zone of southern Australia was developed prior to the workshop and presented to participants based on industry summaries compiled by Campbell et al. (2014). The case study depicted an average beef specialist farm in southern Australia's high rainfall zone (annual rainfall 500-1000 mm) on 704 ha, with 420 cattle on hand, including 212 breeders. Participants were asked to critique through a facilitated session both the representative case study and related calendar of operations for the farm under two alternate calving systems, an autumn and winter/spring calving pattern. Participants suggested that the winter/spring calving system was the most progressive and representative of the two systems presented and as such, this was system used as the basis for the balance of the workshop.

The group were then tasked to identify the key decision points where seasonal forecasting could be useful using the calendar of operations as a basis for discussion. Once identified the relative sensitivity of the decisions were explored by the participants, by examining the key drivers and the relative weighting of each driver in the decision process using coarse driver condition descriptors.

Results

In the spring/winter system, calving occurs from mid-July through to mid-September matching peak pasture growth (MLA 2016) with highest energy demand from the herd (lactating cows). In this system typically only a small proportion of weaners are sold in March (8-10 months of age) and the rest carried through to November were they are sold at higher weights e.g. steers 500-550 kg.

The group identified that the decision on how many progeny to sell as weaners in March was a key decision point in the system as it limited later earning potential (i.e. sale of animals as grown steers and excess heifers). Indeed, no other key decision point was identified as being sensitive to seasonal climate forecasts (but weather forecasts were seen as useful). Using this identified decision point, the group identified four influential drivers to the decision of how many progeny were sold in March as weaners. These were; cash flow, relative price of weaners, feed availability (surrogate for feed on hand, stored feed and animal condition) and the seasonal outlook for rainfall (March, April and May). Participants indicated that the;

- relative financial position of the business was a key driver with those in need of cash flow encouraged to sell more weaners to meet financial obligations
- relative price of weaners also drove the decision to sell stock early with higher prices in March encouraging greater sale rates of weaners
- feed availability and animal condition influenced decision making, with low feed reserves and poor animal condition encouraging early selling, and
- seasonal outlook for rainfall was also a driver, with predicted wet outlooks discouraging early selling and dry outlook encouraging early selling. In this instance, rainfall was considered a surrogate for likely pasture availability

The relative sensitivity of the March decision point to each of the four drivers was explored using coarse condition descriptors of each of the drivers . Participants were presented with a matrix depicting the range of combinations for each of the drivers and asked as a group, given various values of the four drivers, the likely selling response of the farmer. Table 1 summarises the participant responses for likely percentage weaner sell decisions for different antecedent and forecast conditions.

Discussion

In reviewing the responses from the group it is apparent that the decision to sell progeny as weaners in March was sensitive to both antecedent and forecast conditions, including seasonal rainfall outlooks (March, April, May). Ranked on relative influence the hierarchy of drivers appeared to be; the need for cash flow, relative price of weaners, feed availability and seasonal rainfall outlook. Using the combination of; average weaner price, average feed availability and average rainfall outlook as a base line on which to make a comparison (Table 1, top two lines) it can be seen that those with low cash flow forego potential higher future later seasons earning more often, selling on average 35% more stock in March than the farmer with ‘Ok’ cash flow. Similarly the percentage of weaners sold under the various driver combinations considered was more extreme for the ‘low’ cash flow scenario with the range of 45-85% considered compared to the ‘Ok’ cash flow scenario which was 10-50%.

When evaluating these responses across all possible combinations, it is apparent that inconsistencies could easily arise. However, the purpose of this elicitation was to discover the primary drivers of decision points that are potentially sensitive to seasonal climate forecasts, not determine the optimal decision. The difficulty of the participants, and researchers, to maintain consistency across the likely sell decision highlights this optimisation would be better suited to modelling procedures, which is the intended next step.

Table 1. Winter/ spring calving sell decisions with different options for the influential factors as determined in consultation with industry. Seasonal rain forecast is for the three months March, April and May expressed as tercile groupings (dry, average/climatology and wet).

Cash flow position	Price weaners	Feed available	Seasonal rain forecast	%sell
Okay	Average	Average	Climatology	10
Low	Average	Average	Climatology	45
OK	Low	Low	Dry	50
Low	Low	Low	Dry	85++
OK	Low	Low	Climatology	20
Low	Low	Low	Climatology	75
OK	Low	Low	Wet	10
Low	Low	Low	Wet	65
OK	High	Low	Dry	50
Low	High	Low	Dry	85++
OK	High	Low	Climatology	70
Low	High	Low	Climatology	75
OK	High	Low	Wet	10
Low	High	Low	Wet	70
OK	Low	High	Dry	10
Low	Low	High	Dry	45
OK	Low	High	Climatology	0
Low	Low	High	Climatology	40
OK	Low	High	Wet	0
Low	Low	High	Wet	40
OK	High	High	Dry	30
Low	High	High	Dry	60
OK	High	High	Climatology	10
Low	High	High	Climatology	50
OK	High	High	Wet	0
Low	High	High	Wet	75

Conclusion

Through the development of this methodology and within this case study, it is apparent that the number of key decisions points sensitive to seasonal climate forecasts are relatively few and the decision environment is complicated by a number of other drivers which have precedence over seasonal climate forecasts. This qualitative low cost and rapid method of industry engagement has helped ground this ongoing research and serves as a model of working with the agricultural sector collaboratively exploring risk management. Indeed a similar approach has been applied to other systems (e.g. winter cropping, cotton, rice) with insights into appropriate contextualisation of forecasts within farm decision environments gained. This targeted and considered elicitation has provided key foundational information for biophysical and economical modelling, providing greater confidence results of the value of seasonal climate forecasts will be more likely appropriately represented within the management decision environment.

References

Campbell M., King B and Allworth M (2014). The south Australian beef industry. In: Beef Cattle Production and Trade 10 ed. D Cottle and L Kahn Eds. pp. 185-205. CSIRO Publishing, Australia.

MLA (2016). Pasture Growth. (http://www.mla.com.au/Research-and-development/Grazing-pasture management/Native-pasture/Pasture-growth).

CIE (2014). Analysis of the benefits of improved seasonal climate forecasting for agriculture, The Centre for International Economics. Sydney, Australia. pp 50. (http://www.managingclimate.gov.au/wp-content/uploads/2014/06/MCV-CIE-report-Value-of-improved-forecasts-agriculture-2014.pdf).