Seasonal Climate Forecasting for More Effective Grain-Cotton Production Systems (joint CRDC/GRDC project DAQ104C and DAQ469)

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Cropping is a risky business. Our highly variable climate makes it difficult to decide how best to manage crops and cropping systems. What works well one year might not works well the next. To develop better risk management practices, this project uses the APSIM cropping systems model to examine the profitability and sustainability of a range of alternative dryland cotton/grain cropping systems throughout the northern grain region of eastern Australia. It involves working closely with farmer collaborators in Central Queensland, the Darling Downs, the northwest slopes of NSW and the Liverpool Plains.

Climate varies at a range of time scales, the best known being the El Niño/La Niña phenomenon. An earlier LWRRDC funded Climate Variability in Agriculture project (QPI44) has identified the importance of other climate phenomena ranging from the Madden-Julian Oscillation (MJO, also known as the 40-day wave) to decadal and multi-Decadal Climate Variability (DCV).

The cyclical nature of rainfall variability within Australia is well known. During the 1950s and 1970s, higher than average rainfall provided opportunities for higher yields and returns, whilst the early 1930s and 1990s brought drought and crop failures in many parts of Australia. The DCV signal (as, for in instance, measured by the Interdecadal Pacific Oscillation or IPO) is a consequence of low frequency oscillation in sea surface temperatures in the equatorial Pacific influencing atmospheric pressure patterns. The impact extends into the sub-tropics – and occasionally even beyond - and appears to modulate the strength of El Niño Southern Oscillation (ENSO) phenomena. A negative (positive) DCV pattern enhances (weakens) ENSO related rainfall in most parts of Australia. An understanding of these climatic cycles and the potential to predict them may provide an opportunity to improve the profitability and sustainability of cropping systems through strategic planning of cropping activities.

In contrast, the MJO is a large-scale atmospheric circulation anomaly that originates in the Indian Ocean and moves eastward into the Pacific Ocean. It has a return period of about 30-60 days and a frequency of about 6-12 events each year. It may have a crucial role in contributing to Australia's non-seasonal climate variability through its effect upon pressure, wind, outgoing solar radiation and temperature. There is evidence that the MJO enhances rainfall activity in the northern wet season (October to March), and the activity of monsoons and cyclones. As part of this project, we will examine the relevance of the MJO in making operational decisions such as early harvesting in order to reduce the risk of losses from rain at harvest.

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Example Analysis

The four-year rotation outlined in Table 1 was assessed over a 100-year period for a property on the northwest slopes of NSW using APSIM.

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Table 1: Dryland cropping rotation used in this assessment.

Year 1		**Year 2**		**Year 3**		**Year 4**	
Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Wheat	Fallow	Chickpea	Fallow	Fallow	Cotton	Fallow	Sorghum

The yields for each crop were simulated and compared between negative DCV and positive DCV years. Current costs and prices were assumed for the gross margin (GM) analysis. Figure 1 shows that the rotation had a higher median GM and a lower overall variability in years when the DCV pattern was negative. We are currently assessing and testing with producers if/how such information can be used to make more profitable management decisions based on such knowledge.

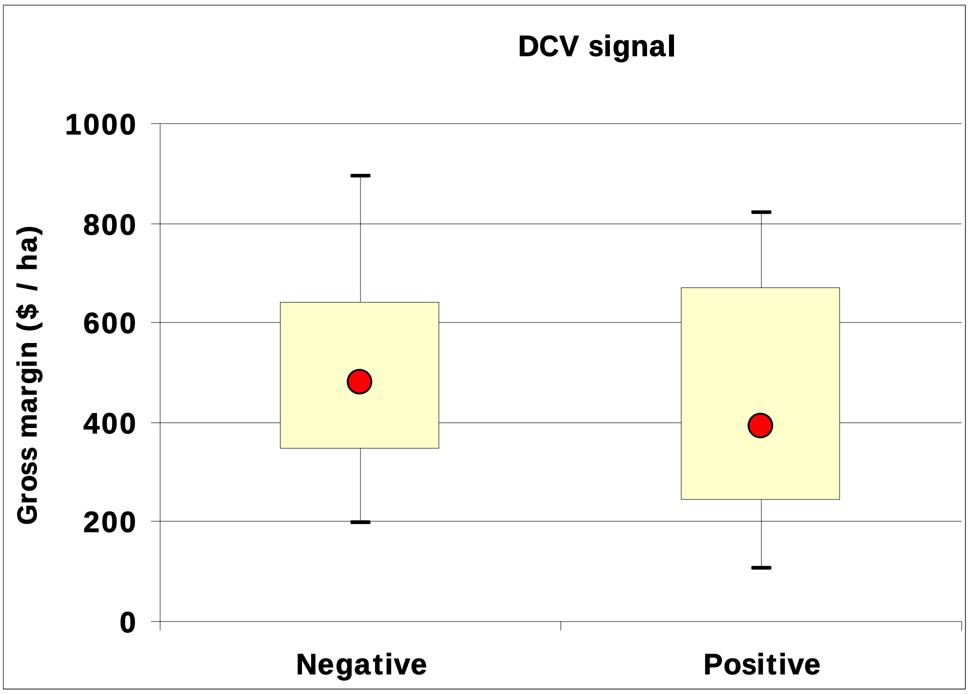

Figure 1: Gross margin analysis for a wheat/chickpea sorghum/cotton rotation for an example farm in Northern NSW. Simulated results over a 100-year period are shown for times when the long-term DCV signal was either negative or positive. The whiskers indicate the 10 and 90 percentile, the boxes the 25 and 75 percentile and the circles the 50 percentile (or median) gross margin, respectively.

The Future

The profitability and sustainability of a range of cropping rotations is being assessed across the Northern Grains Region in cooperation with farmer collaborators. The value of climate forecasting tools at a range of temporal scales is being assessed to determine their usefulness to growers in strategic and operational decision-making.

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