# Improving grain grower business resilience before, during and post drought – ARM Online tools to assist on-farm decision making

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## Key words

drought resilience, decision-support tools, crop rotations, ARM Online

## Take home message

The Agricultural Risk Management (ARM) Online platform (www.armonline.com.au) provides growers and agronomists with digital tools that evaluate the drought resilience of alternative cropping strategies. The platform assists in choosing cropping systems that have both a high level of drought resilience and perform well across further target indicators, such as profitability. Recently, new functionality has been added to the CropARM decision-support tool that focuses on optimising tactical crop management decisions. Furthermore, the new RotationARM tool has been developed to assist in selecting resilient cropping systems. Over the coming months, a series of capacity-building workshops are being delivered to guide growers and their advisors in using these tools to build their drought resilience. Participants will learn to analyse their cropping systems and develop and refine their own rules of thumb.

## Introduction

Drought is characterised by abnormally dry conditions when the amount of water available is not enough to meet the typical usage across the community and environment (BOM 2019). Agriculture is the first sector affected by drought and is the most severely affected part of the economy. It absorbs 80% of the direct impacts of drought exposure (FAO 2023). Not only does production decrease but food security and the livelihoods of those who live and work in rural communities are also negatively impacted. Weather and climate risks have always been present in Australian agriculture and Australian farmers are continuously developing new ways to managing these risks in their business operations. However, drought remains a persistent and challenging risk for dryland grain growers. Since droughts are an enduring part of the Australian landscape and are difficult to predict, they must be mitigated through proactive preparation that builds resilience into farming systems. Resilience means that a system can absorb shocks and is capable of regenerating after the disturbance. Drought result in significant personal and communal hardship. Therefore, growers and government are continuously seeking ways of managing these risks from both operational and financial perspectives.

Personalised decision-support tools with the capability to bench test alternative cropping scenarios can enable growers to develop resilient cropping systems well before the next drought. In this project, we have updated and added functionalities for drought analysis into the CropARM tool and have created a new tool called Rotation Agricultural Risk Management (RotationARM) that allows growers to analyse current and potential cropping systems across a range of performance metrics. These tools are part of the ARM Online platform (https://www.armonline.com.au/) and use the APSIM Next Generation cropping systems model (Holzworth *et al*. 2018) as their engine. This puts the collective knowledge from over 60 years of

research on how crops grow and interact with the environment (Keating 2024) into the hands of growers and advisors via a user-friendly interface.

## Optimising crop management in CropARM

CropARM is an online version of the WhopperCropper tool (Cox *et al.,* 2004). It enables users to analyse the impact of cropping decisions such as sowing date, plant density, cultivar choice and nitrogen fertiliser rate on their local soil and climatic conditions. It presents results through a series of graphics enabling users to compare crop management options and identify the best management choices for their risk preferences and long-term objectives.

New functionality has been implemented into CropARM enabling users to assess the impacts of local and national droughts on their crop performance. The user performs the analysis in CropARM by specifying their crop management. Once they inspect the overall results, they can overlay the analysis with drought conditions with the option to select:

- specific local droughts (based on the ratio of rainfall to potential evapotranspiration; Dalezios *et al.,* 2017) or
- nationally recognised droughts (defined by BOM 2020).

Figure 1 shows an analysis of wheat grown at Goondiwindi. The top figure highlights the years when Goondiwindi experienced drought conditions (indicated by the shaded background). The bottom figure shows the major nation-wide droughts. The impact of prolonged drought on crop yields can be clearly seen and can differ between the local and nationally recognised droughts.

One potential strategy for building drought resilience is to adopt less commonly cultivated crops. As CropARM uses APSIM as its analytical engine, only the specific crops included in the model are available for analysis. To allow an analysis of additional crop options that are not yet available in APSIM a new method to statistically simulate seasonal crop yields has been implemented into CropARM. This method is based on an adjusted triangular distribution function and simply requires the user to define the crops growing season, as well as the minimum, maximum and average expected yield. Figure 2 demonstrates this analysis in combination with the drought analysis for pigeon pea grown at Goondiwindi (values for demonstrative purposes only).

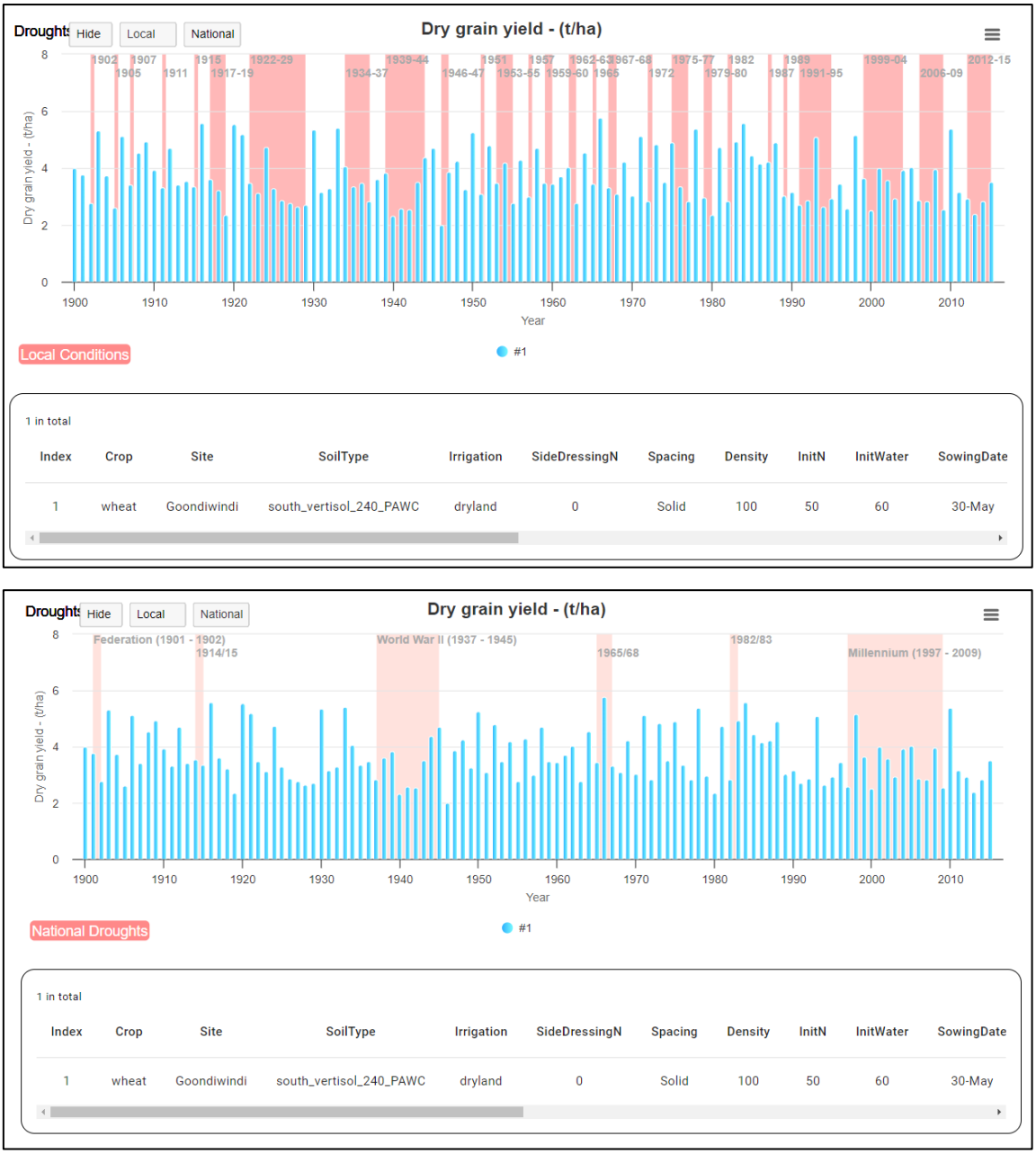


**Figure 1.** A local and national drought analysis performed in CropARM for wheat grown at Goondiwindi. The top panel shows the analysis overlayed with local drought conditions (shaded), while the lower panel shows the analysis overlayed with national drought conditions (shaded).


**Figure 2.** An analysis of pigeon pea grown at Goondiwindi using statistically derived crop yield in combination with the drought analysis functionality in CropARM.

## Optimising the overall cropping system in RotationARM – a new tool

A key part of preparing for drought is setting up the cropping system for increased resilience. Rotation Agricultural Risk Management (RotationARM) has been developed to enable the analysis at a whole system level that considers the interactions between subsequent cropping decisions. Users specify their location, production costs, prices, crops grown, the cropping intensity (crops/year), production inputs and sowing rules. The tool then presents results for key system performance metrics (Figure 3) such as overall gross margin, achieved cropping intensity, water use efficiency, soil carbon levels and surface organic matter cover. Further analysis can be undertaken to compare different systems and intensities under different drought exposure scenarios, allowing the user to identify the system that best meets their objectives in a drought-resilient manner.

## Building drought resilience within the broadacre cropping sector

These tools are designed to help growers identify system-level options and create or refine cropping decision rules of thumb. To facilitate the use of these tools a series of one-day workshops (Zull *et al.*, 2024) are being delivered across Queensland and northern New South Wales in the coming months. These workshops will enable growers and advisors to:

- Identify tactical crop management decisions that improve resilience during drought exposure
- Compare strategic choices between different crop rotations to increase drought resilience as part of preseason planning
- Develop personal learnings and rules-of-thumb (improve drought resilience)
- Understand how to improve drought resilience into the future (continued improvement).

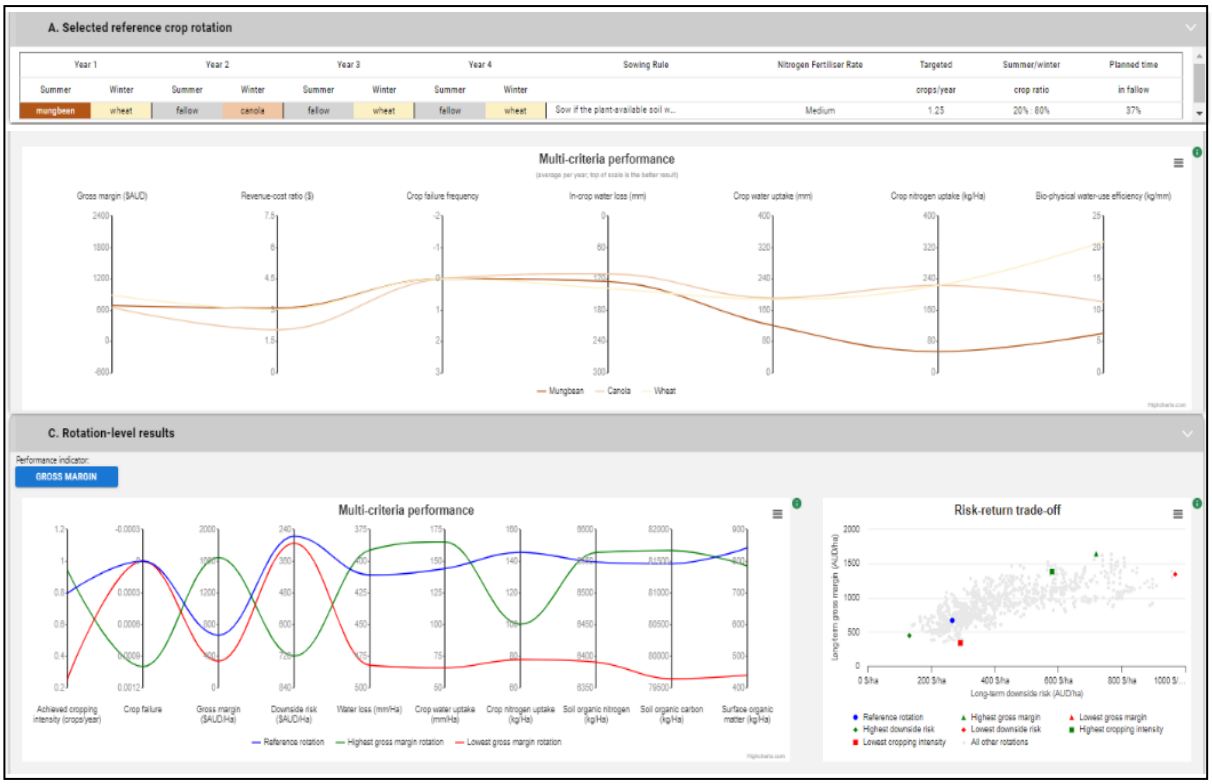


**Figure 3.** The results of an analysis of a wheat-canola-mungbean cropping systems at Goondiwindi in RotationARM.

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