Fact sheet

NORTH WEST LOCAL LAND SERVICES

30 June 2021

Profitable crop rotations in the Liverpool Plains

Key Points

- Frequency is important - rotations that approach a cropping intensity of one crop per year or slightly less tend to be more profitable.
- In dryland situations rotations involving cotton are not necessarily the most profitable.
- Sequences involving diverse crop types are not necessarily more profitable but may have more stable income.
- Sequences requiring higher additions of nitrogen tend to be more profitable.

Characterised by high productivity and crop diversity, growers in the Liverpool Plains cropping area face complex crop sequencing decisions. The use of a structured crop sequence can greatly assist farm management, particularly in relation to factors such as income stability, risk management machinery, use of grain storage facilities, and herbicide residues.

The National Landcare Project and North West Local Land Services funded Agricultural Consulting and Extension Services and the CSIRO to investigate the profitability and sustainability of common dryland crop sequences in the region.

Crop sequences were obtained from local agronomists and modelled using the Agricultural Production Systems sIMulator (APSIM) (Holzworth et al.,2014), across five sites on the Liverpool Plains (Breeza, Caroona, Mullaley, Premer and Quirindi). APSIM is a comprehensive model developed to simulate biophysical processes in agricultural systems using local soil and historical climate data. The model generates yield, economic and ecological outcomes of various crop sequences. Management practices that can be explored include starting soil moisture, Nitrogen (N) application, crop maturity type (long or short season varieties) and sowing date.

Modelling enables a crop sequence to be “tested” over a large number and variety of seasons at no risk to the grower and shows the relative strengths and weaknesses of different systems. When interpreting the results of modelling, growers and agronomists must take into account weed and disease interactions that APSIM does not model.

The key economic indicators generated are gross margin per hectare per year ($/ha/year), number of negative gross margin crops and marginal rate of return. The key sustainability and efficiency indicators are water loss from the system through drainage and runoff, and nitrogen use.

Guidelines for simulation

Fallow sprays occurred after 30mm of rain with a minimum of 20 days between sprays. To plant, the model used three different starting stored moisture triggers 200, 160 and 100mm (less for mungbean). Crops were planted within the sowing window as soon as the stored moisture trigger was reached. If fallow rainfall was insufficient to obtain the trigger, the crop was planted at the end of the window. Fertiliser was applied to provide 200 kg N at sowing for all crops. Gross margin costs are as calculated by Qld DAFF and commodity prices are a 10-year average price. The model ran using climatic data from 1957 to 2020 inclusive in order to test the rotations over many seasons.

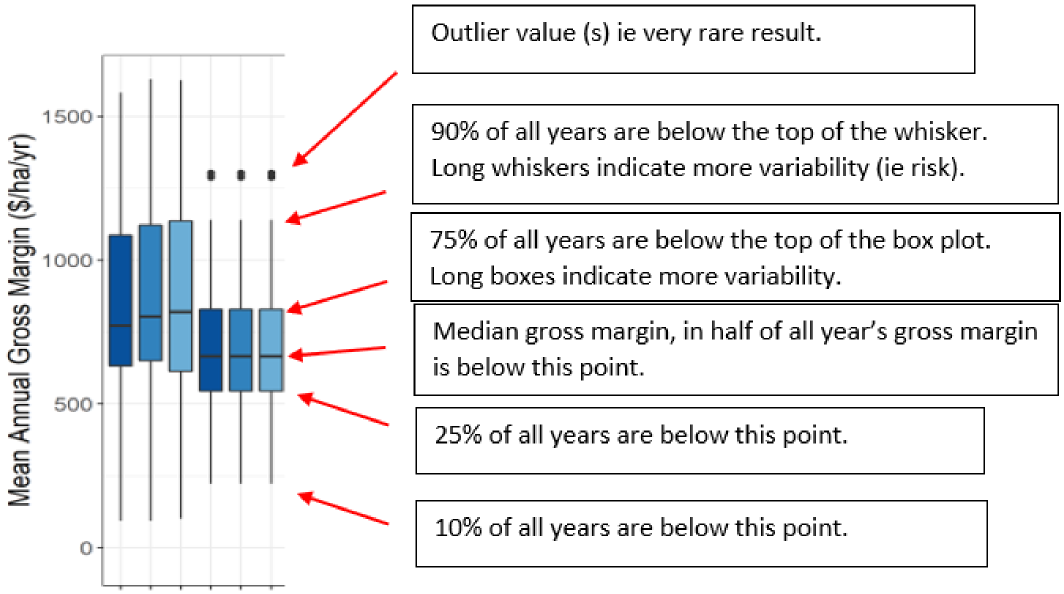
Description of rotations

The graph of annual gross margins (Graph 1) identifies crops as (B) barley, (Co) cotton, (Ch) chickpea, (Ca) canola, (Mg) mungbean, (Mz) maize, (S) sorghum, (W) wheat an (X) fallow (summer or winter). Starting soil water is indicated as 200 mm (sw1, dark blue), 160 mm (sw2, blue) and 100mm (sw3, pale blue). A simple sorghum long fallow wheat rotation (Table 1) planted on 200mm moisture is expressed as SXXW_SW1.

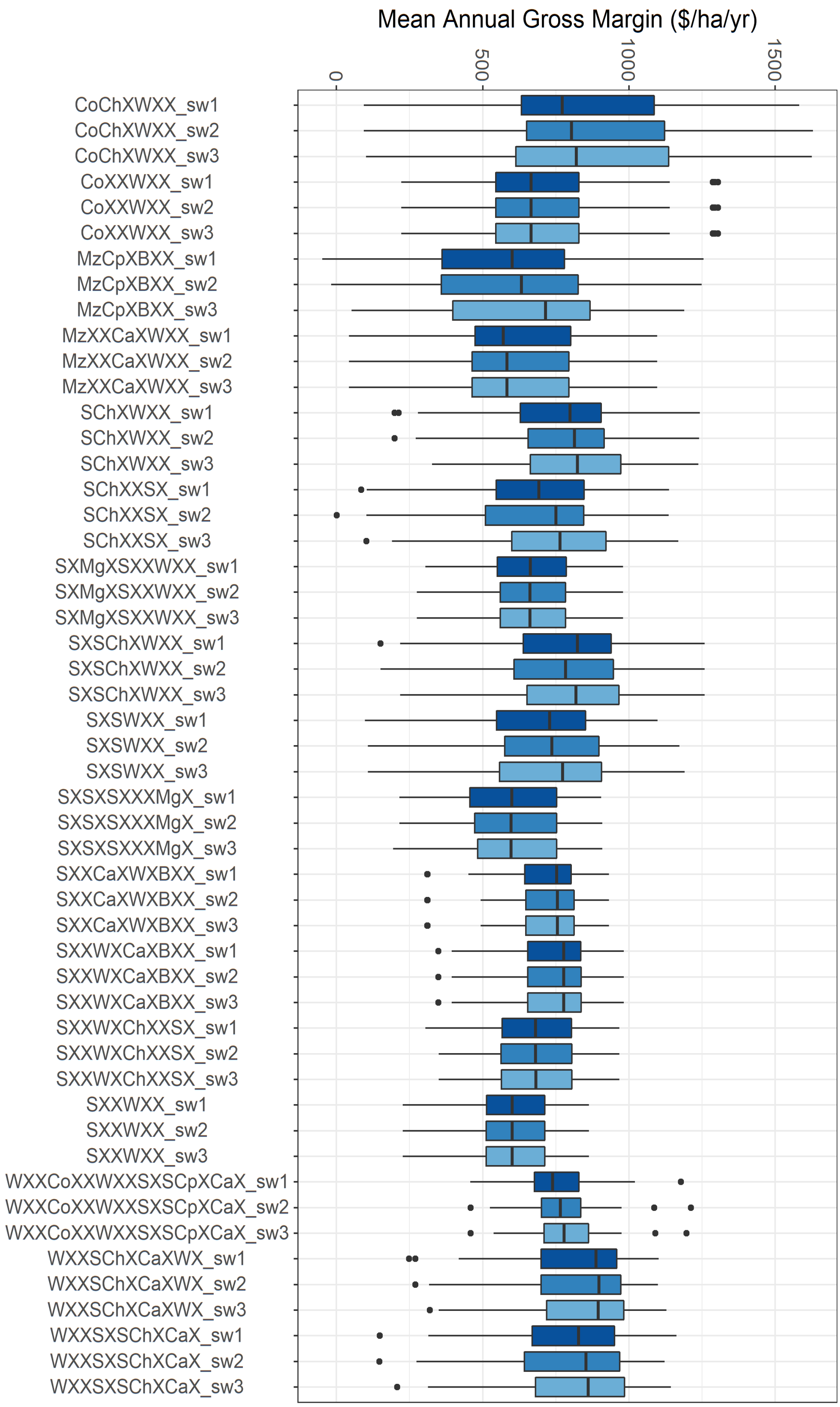
Table 1: Example rotation – sorghum long fallow wheat.

Yr 1 winter	Yr 1 summer	Yr 2 winter	Yr 2 summer	Yr 3 winter	Yr 3 summer	Yr 4 winter	Yr 4 summer
	sorghum	X	X	wheat	X	X	

Reading Graph 1 (box and whisker plot)



Graph 1. Gross margin of crop sequences at Breeza.



Results

As gross margins are expressed as $/ha/year it is important to remember that small differences between rotations can result in a large variation in income when multiplied by many hectares over many years.

Location

Location made little difference to the relative profitability of the rotations, indicating that the sequences gave similar relative economic results across the Liverpool Plains and for this reason only one site is included here – Breeza.

Starting water

In graph 1 the same rotation with the three different starting waters were grouped and it can be seen that differing starting moistures produced small differences in gross margin and mostly the highest starting water gives little or no benefit. There are several reasons for this:

1. In many cases fallow moisture had reached 160-200 mm by the start of the sowing window meaning that the impact of lower moisture was not tested.
2. The yield penalty in delaying sowing to give greater moisture storage may be greater than the benefit of increased stored moisture and in any case the earlier sown crop still gets the moisture as in-crop rain that the later sown crop gets as stored soil moisture.

Crop type

Cropping diversity did not have a strong impact on profitability although longer rotations such as WXXCoXXWXXSXSCpXCaX had a relatively stable gross margin as risk is spread over many crops over many years.

Sequences including cotton did not give reliably higher mean gross margin although there was greater variation between good and poor results (longer whiskers) i.e. more risk. This is likely due to the high moisture use by cotton and the long fallow prior to cotton limiting opportunities for other crops.

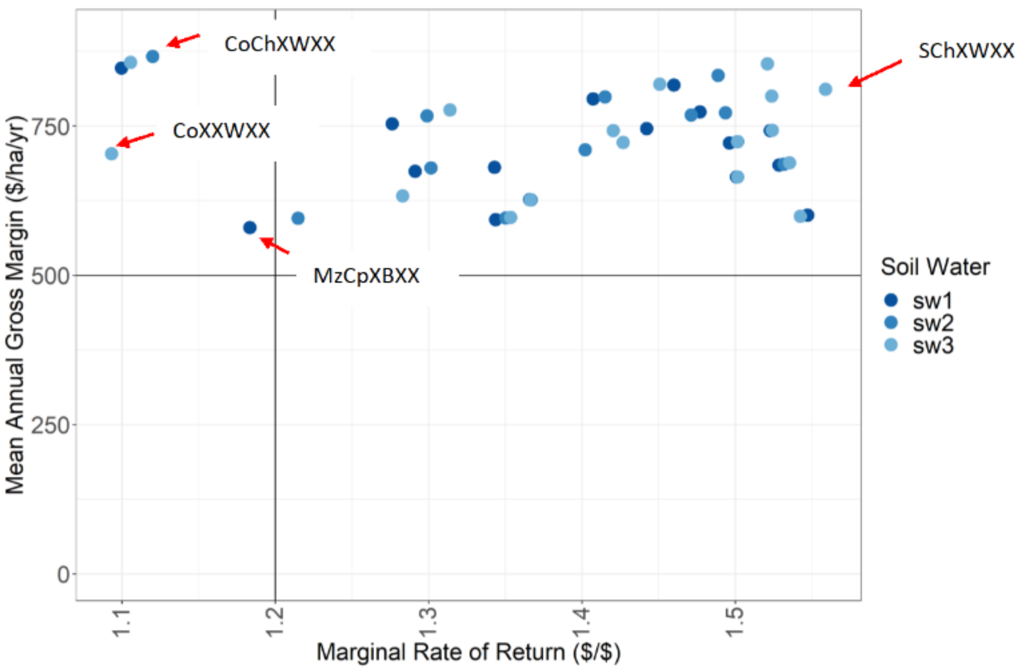
Crop frequency

Sequences with higher cropping frequencies i.e. one or just below one crop per year, tended to be more profitable. This in part explains the higher profitability of the sorghum double crop chickpea/ wheat rotation that has a cropping frequency of one crop per year compared to the sorghum long fallow wheat rotation.

Trade-offs

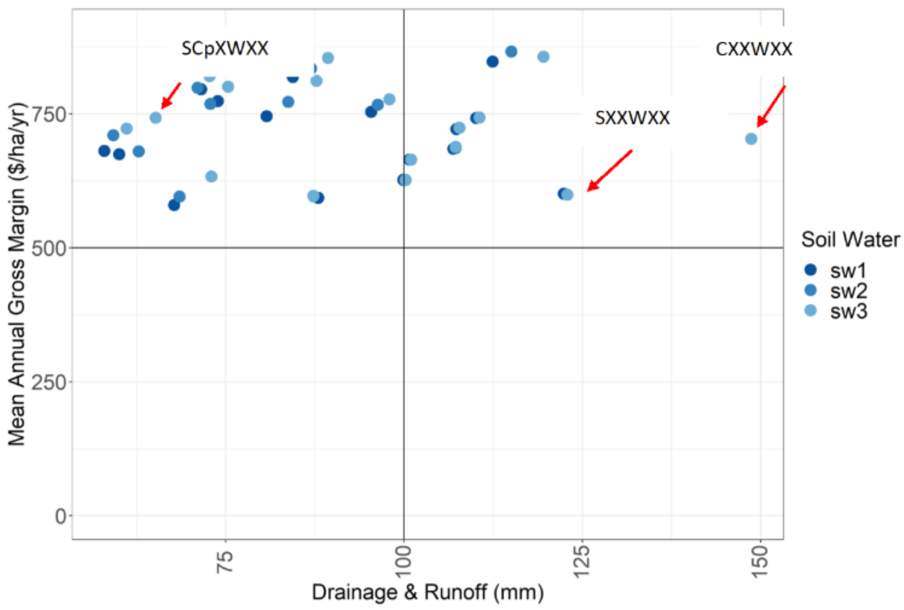
Consideration was given to potential trade-offs between annual gross margin and other economic and environmental factors. Graph (2) below shows the annual gross margin and the marginal rate of return (numbers of dollars returned for every dollar spent) for various sequences. Rotations involving cotton fall to the left-hand side of the graph indicating they gave a low rate of return compared to some other crops. These rotations may be less suited to businesses with low cash reserves. SChXWXX gave a high marginal return and a relatively high gross margin.

Graph 2: Mean annual gross margin verse marginal rate of return.



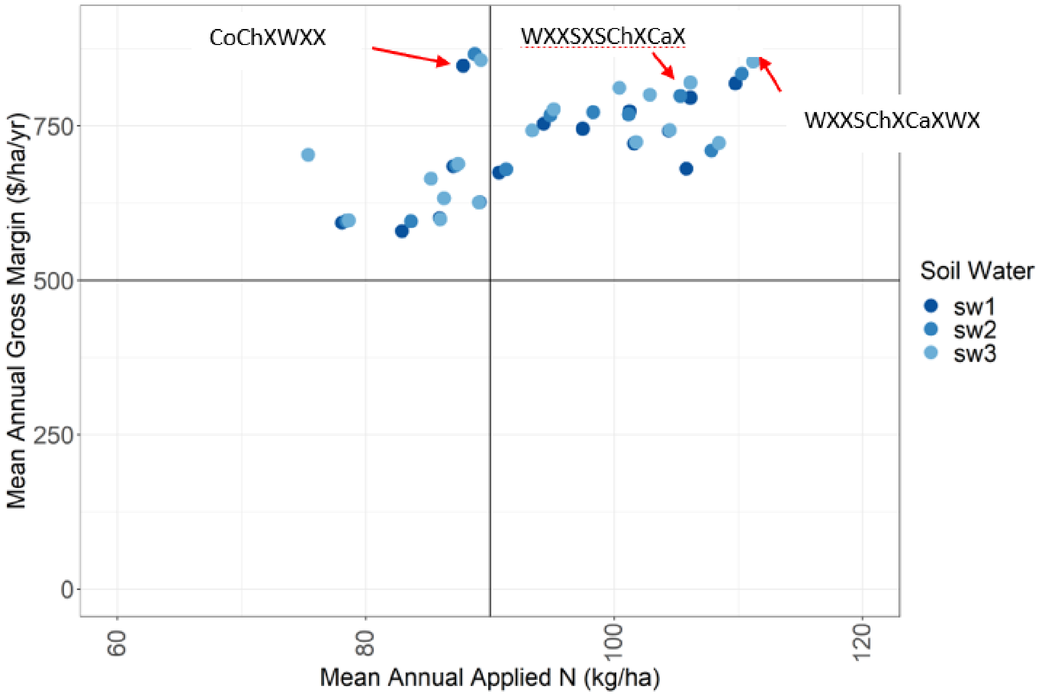
Graph (3) below compares the gross margin to the combined water loss through drainage and runoff. Less intense sequences fell to the right of the graph with higher water loss, while more intense sequences fell to the left. This graph gives an indication of the cropping frequency required to fully use water resources.

Graph 3. Mean annual gross margin verse drainage and runoff.



Graph (4) below shows that rotations requiring more N application to achieve 200 Kg N at sowing tended to be the more profitable, note that two sequences containing canola provided higher gross margin with higher N input. The CoChXWXX rotation however, provided higher gross margin with relatively low N application.

Graph 4. Mean annual gross margin verse applied Nitrogen (N).



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More information

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References

Holzworth, Dean P., Neil I. Huth, Peter G. deVoil, Eric J. Zurcher, Neville I. Herrmann, Greg McLean, Karine Chenu, et al. "APSIM – Evolution towards a New Generation of Agricultural Systems Simulation." *Environmental Modelling & Software* 62 (December 2014): 327–50. https://doi.org/10.1016/j.envsoft.2014.07.009.

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