Quantifying drivers of crop-livestock integration
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Introduction to climate adaptation project in WA mixed-farms
• Modelling mixed farms and outputs for risk assessment
• Livestock-cropping interactions in 2030
• Risk assessment for current climate
• Discussion & feedback

Mixed farm modelling
• AusFarm is...
• Coupling APSIM and GRAZPLAN
• Can be configured for mixed farming systems
• Management: via rule-based scripts

Framing a risk assessment
Biophysical model to
• Biophysical processes have to be linked with decision-making processes to enable simulation of changes, the impacts of management decisions on the biophysical system but also the feedbacks,
• Feed to economic calculation e.g. distribution function to evaluate risk and return
Risk measures:
• Value at risk
  Conditional value-at-risk as a measure of downside risk; as used here, CVaR is the average of the gross margins in the worst 20% of financial years.
Return measures
• Expected return

Historical climate
Increase in frost days

Cunderdin

- annual frost days (min < 2°C)
- 10 years moving average

Transformational adaptation project
• Examine adaptation options that provide resilience to likely climate change for a range of land managers with mixed grazing/cropping enterprises.
• Consider the effectiveness of adaptations at multiple scales (farm, community and region) and against multiple criteria (profit, risk, environmental impacts, GHG emissions and community impacts).
• Consideration of more systemic and transformative adaptation options derived from effective packaging of multiple incremental changes.
Some characteristics of the work

- 29 team members across states
- Broad spatial coverage,
- Building complex (current) systems
- Diverse soils, crops, pasture, livestock, rotation systems
- Stakeholder engagement
- Modelling changes in management practice and modelling farmer choice
- Model input & Verification through workshops (and observations)
- Designing work flows for large simulations
- On-job training (DPI, DEPI, SARDI, BCG)
- Maintaining model consistency across transects

Model outputs

Example: Metrics in 2030 compared to a baseline (1980-1999)

- Mulleea
- Drought
- Water
- Livestock
- Nitrogen
- CO2
- $ Climate
- NRM WUE production

A large set of outputs for
Productivity, profitability, risk assessment, NRM, GHG emission, adaptation-mitigation tradeoffs, water & nitrogen stress

Levels of integration

1. a cropping-only system ("C") - wheat, canola and barley; 100%
2. a livestock-only system ("L"); 100%
3. a segregated mixed farming system ("S") in which the "C" and "L" management systems (54% and 46% of farm area) were allocated to the soil types better suited to each activity; 54%
46%

Transformational adaptation project

Representative mixed farms
- Katanning
- Cunderdin
- Merredin
- Mulleea
- Salmon Gums

Interactions between financial outputs of livestock & cropping

Less sensitivity of pasture and livestock to changes in climate in 2030

Levels of integration

4. mixed farm with rotations of 3-5 year phases of legume-based pastures and grain crops on the better soil types ("R");
5. a “strategically synchronised” mixed farm ("SS") in which the "R" management system was further integrated
6. a “tactically synchronised” mixed farm ("ST");
Financial risk assessment (up to Gross margin) of different levels of livestock-cropping integrations

Cropping and livestock production are assumed to be operated on a single soil type and completely segregated in space and time. Gross margin statistics are calculated over the 40 years 1973-74 to 2012-13. “C” denotes production systems that are 100% cropping, “L” systems that are 100% livestock.

Conditional value-at-risk: the average of the gross margins in the worst 20% of financial years.

Systemic to transformative adaptation

• Elicited adaptation options are very locally-specific
• Alteration of the crop-livestock balance,
• Low-variability to high-intensity mixed farming,
  1. low risk and low return approach
  2. Medium risk and medium return approach
  3. High risk and high return approach.
• Segregation + perennial pastures,
• Seasonally responsive farming.

Risk assessment of above packages

Thank you very much.