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Economics of perennial wheat – an Australian farming systems case study

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Why economics?

- Input to the investment ‘business case’
- Provide insights to potential for technology adoption
- Evidence about relative importance of plant traits
- Thresholds for evaluation of R&D progress

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Context for the study

- Complex target farming system(s)
- Great uncertainty about perennial wheat (bio-physical and economic relationships)
- Output relevant to a long time frame

Analysis technique

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- Regional case study
- Whole-farm bio-economic modelling
- Sensitivity analysis
  - Uncertainty about many assumptions
  - Understand the impact of assumptions on profitability
  - Critical levels for profitability including:
    - Grain yield
    - Grain price
    - Amount and timing of additional forage provided
    - Grain only vs. dual purpose

Modelling format - MIDAS (Model of an Integrated Dryland Agricultural System)

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- Whole-farm model of a mixed crop/livestock enterprise
  - Includes multiple crop options and rotations, livestock, soil types, inputs/costs (fertiliser, machinery, labour etc)
  - Version used - Central wheat-belt of Western Australian
- Linear-programming approach
- Optimises farm profitability (subject to constraints)
- Steady-state (average season)

The 'central wheat-belt' version of MIDAS

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Basic model design

- Farm size of 2000 ha
- 8 land management units/soil types
- Mediterranean-type climate - 350–400 mm of rainfall annually; 75–80% falls in the winter-spring growing period (May–October).
- 9 periods over production year - start or 'break' of the growing season, and finishing with 2 periods over summer and autumn after crop harvest.
- Farm runs a mix of crop and livestock enterprises
- Merino sheep flock for wool production is the 'base' livestock enterprise
- Cropping systems involve 70 different rotations of pastures and annual crops including wheat, barley, lupins, canola and alternative grain legumes, such as field peas.
- Each requires production parameters - grain yield, grain quality, grain protein levels and germination and growth rates of pasture

‘Adaptations’ for modelling perennial wheat

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Added 5 new rotations into the mix of options (all 6 yr)

- 3 yrs perennial wheat » 3 yrs annual pasture
- 3 yrs perennial wheat » 1 yr grain legume » 2 yrs wheat
- 2 yrs perennial wheat » 1 yr grain legume » 1 yr wheat » 1 yr legume » 1 yr wheat
- 4 yrs perennial wheat » 1 yr grain legume » 1 yr wheat
- 6 yrs continuous perennial wheat

Key assumption

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Grain yield (average)

- Perennial cereal = 60% of annual wheat

Grain price

- Perennial cereal = $35/t < milling wheat

Variable input costs

- Annual wheat - $195
- Perennial wheat - $148 ($95 second year)

Additional green forage available

- 1560 kg (total of early summer and autumn)

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Grain only (no extra forage value)

Perennial cereal for grain only was not profitable under base assumptions

- $25-$120/yr less than best alternative
- Difference lower on soil types less suited to wheat
- Near yield parity for perennial wheat use require if price penalty apples

Dual-purpose scenario

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	Without perennial grain	With perennial grain	Change
Farm profit (AU$'000)	111.2	152.9	+41.8
Profit/ha (AU$/ha)	55.6	76.5	+20.9
Area of perennial grain (ha)	0	400	+400

Providing additional forage for grazing greatly improved attractiveness of a perennial cereal

- Increased sheep numbers and stocking rate

Extra forage production – time and amount

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% of additional forage available in base scenario	% of perennial cereal on farm that optimises profit		
	Before & after season break	Only after season break	Between harvest & season break
100	20	12	11
75	16	10	13
50	13	13	0
25	11	11	0

Note: Small amounts of extra forage(as little as170 kg/ha) - especially when available after season break – strongly impact perennial wheat use

Key findings

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- Perennial wheat has some long term commercial prospects
- Greatest impact likely from a dual purpose product (crop/livestock enterprises)
- Low yields and prices can be offset by low input costs and extra forage production
- Initial yield objective of 60% supportable
- Grazing traits important – especially autumn production

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Implications for breeding and R&D

- Target adaptation to environments with low annual crop yield
- Yield and quality will be vital in crop only settings
- Forage quality (amount, quality, timing (dormancy), grazing tolerance and persistence will all be critical considerations.

Future challenges in economic analysis

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- Evaluate perennial wheat in competition with other new perennial technologies
  - Long season grazing wheat
  - Novel perennial pastures
  - Pasture cropping
- Complete other regional studies
  - Particularly a typical high rainfall region

Acknowledgments

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Fuller details of the analysis is found in:

Bell, L.W., Felicity Byrne; Mike A Ewing; Len J Wade (2008). A preliminary whole-farm economic analysis of perennial wheat in an Australian dryland farming system. *Agricultural Systems*, 96, 166-174