

Optimising the efficiency of farming systems in southern NSW



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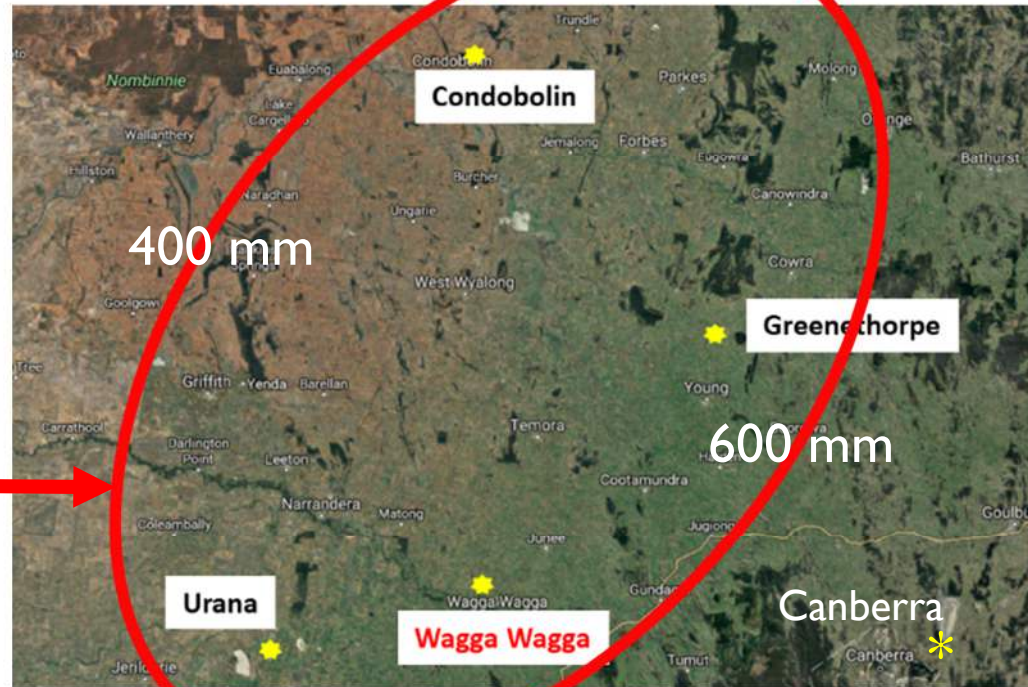


Department of Primary Industries
and Regional Development

Southern NSW – soils & climate

- Equi-seasonal rainfall: 400-600 mm/yr

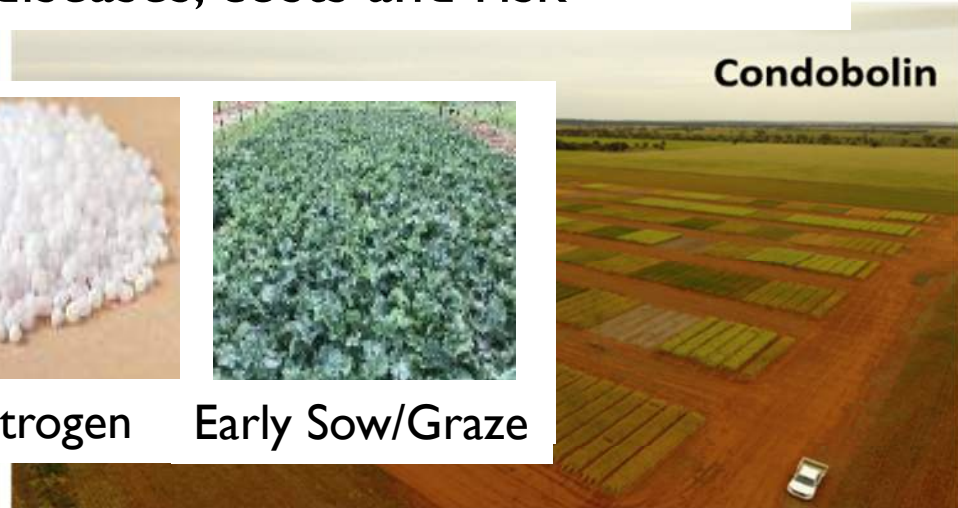
Gradational
acid loam



Sth NSW Farming Systems Project



- convert rainfall into more profit **across a crop sequence**
- manage soil fertility, weeds, diseases, costs and risk



Diversity



Nitrogen



Early Sow/Graze

Systems for comparison

Treatment description	Sequence	N strategy	Sowing time
Baseline	canola-wheat-barley	Decile 2 (~60 kg N/ha)	Timely
Intense Baseline	canola-wheat		
Diverse low value	(faba/lupin)-canola-wheat		
Diverse high value	(lentil/chickpea)-canola-wheat	or	or
Diverse (mix)	vetch-canola-wheat	Decile 7	Early
Continuous wheat	wheat-wheat-wheat	(~120 kg N/ha)	
Fallow	fallow-canola-wheat		

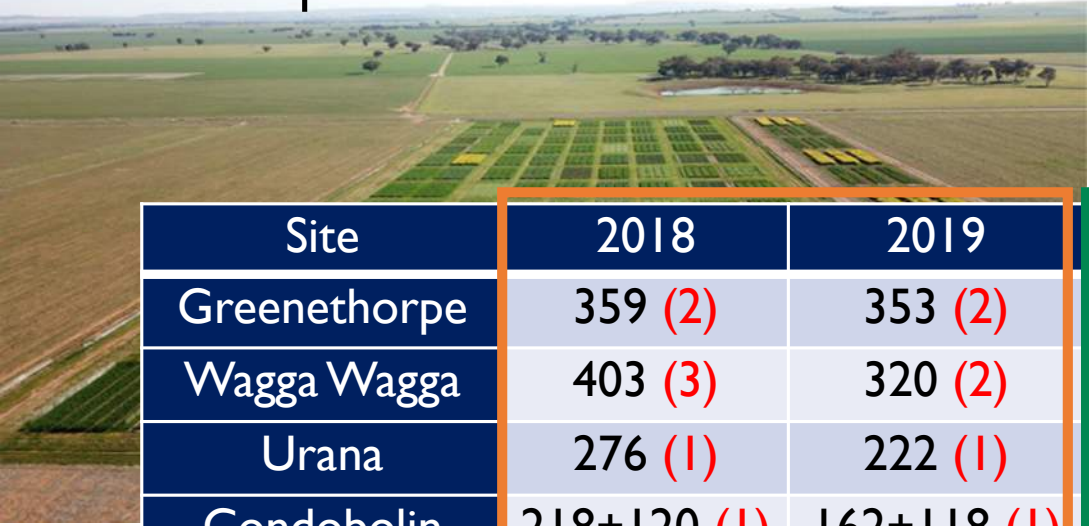
(* all grain-only systems)



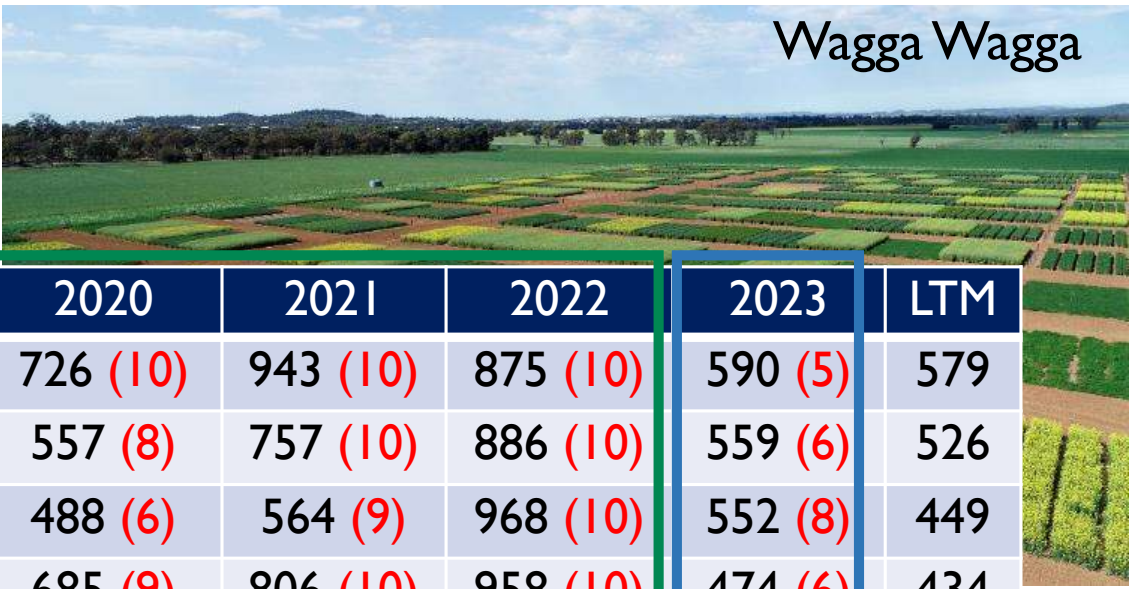
Systems for comparison

Treatment description	Sequence		N strategy	Sowing time
		Cereal%		
Baseline	canola- wheat -barley	(4/6)	Decile 2 (~60 kg N/ha)	Timely
Intense Baseline	canola- wheat	(3/6)		
Diverse low value	(faba/lupin)-canola- wheat	(2/6)		
Diverse high value	(lentil/chickpea)-canola-wheat		or Decile 7 (~120 kg N/ha)	or Early
Diverse (mix)	vetch-canola-wheat			
Continuous wheat	wheat-wheat-wheat			
Fallow	fallow-canola-wheat			

Greenethorpe



Wagga Wagga



Site	2018	2019	2020	2021	2022	2023	LTM
Greenethorpe	359 (2)	353 (2)	726 (10)	943 (10)	875 (10)	590 (5)	579
Wagga Wagga	403 (3)	320 (2)	557 (8)	757 (10)	886 (10)	559 (6)	526
Urana	276 (1)	222 (1)	488 (6)	564 (9)	968 (10)	552 (8)	449
Condobolin	218+120 (1)	162+118 (1)	685 (9)	806 (10)	958 (10)	474 (6)	434

Drought

Wet

Avg Condobolin

Urana



Economic calculations

Gross margin = Gross income – Variable costs

Gross income = Grain yield x spot grain price

Variable costs

- Crop inputs: Seed, fertiliser, pesticides
- Operation costs: Sowing, spraying, spreading, harvesting (all contractor prices)
- Levies, insurance

System WUE (\$/ha/mm)

Sequence GM (\$/ha/yr)
Average Annual Rainfall (mm)

$\frac{\$500/\text{ha (GM)}}{500 \text{ mm (Rain)}} = 1.0 \text{ \$/ha/mm}$

Performance at the system level (2018-23)

- **Urana** (2018-23, avg rainfall 519 mm)

System	Ranked	Margin (\$/ha)	ROI	WUE
			Profit/Cost ratio	Systems WUE (\$/ha/mm)
Baseline (C-W-B)	6 of 10	813 (43)	1.03	1.56 (0.08)
Intense (C-W)	8 of 10	679 (90)	0.83	1.31 (0.17)
Diverse (L-C-W)	1 of 10	987 (86)	1.32	1.91 (0.17)



- **Wagga Wagga** (2018-23, avg rainfall 597 mm)

Baseline (C-W-B)	2 of 16	885 (28)	1.01	1.48 (0.05)
Intense (C-W)	7 of 16	751 (33)	0.82	1.26 (0.09)
Diverse (L-C-W)	4 of 16	790 (36)	1.07	1.32 (0.06)



[0.8 - 1.4]

[1.2 - 1.9]

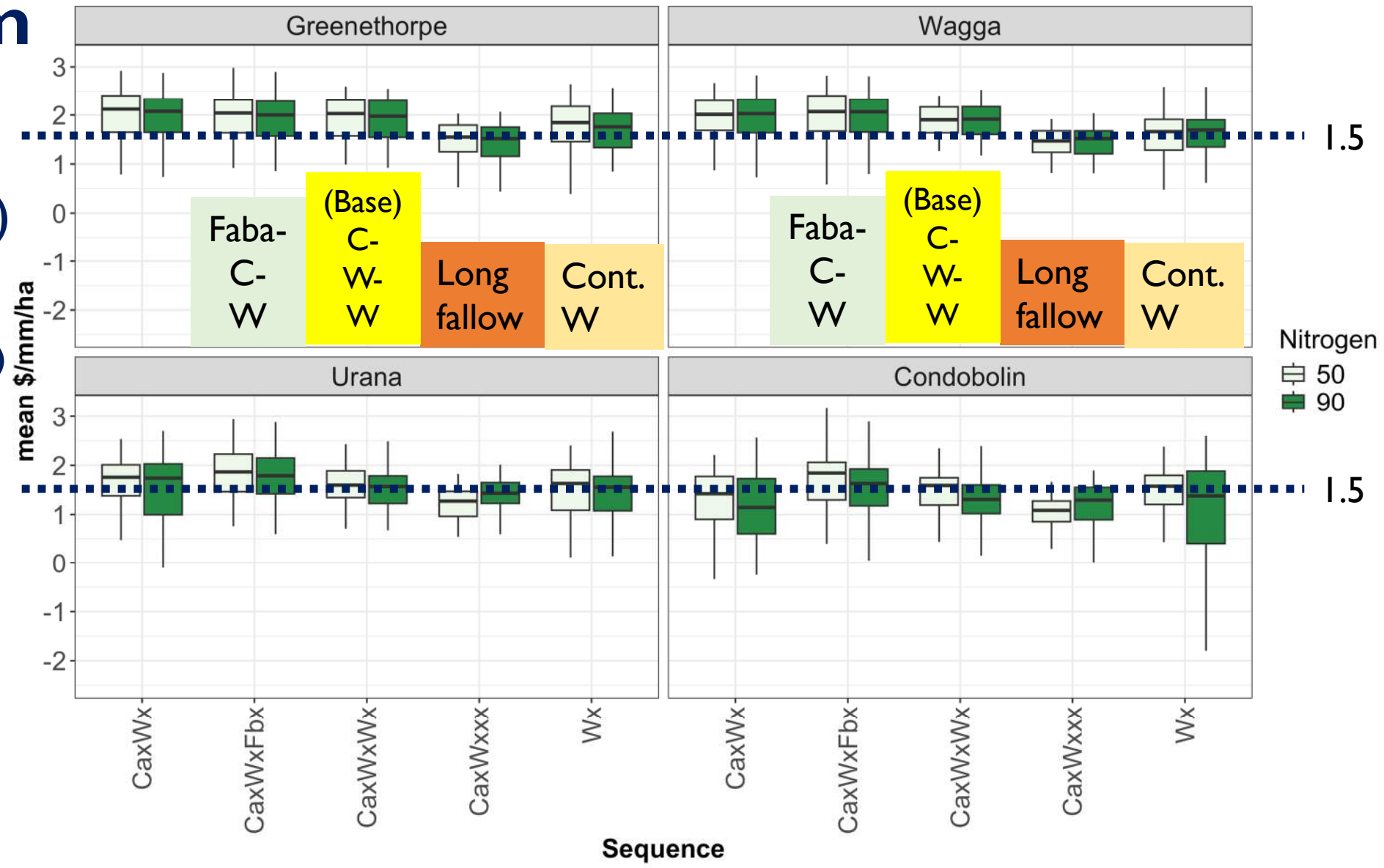
[0.6 - 1.1]

[0.7 - 1.5]



Water use efficiency of alternative cropping systems in Southern NSW

System
WUE
 (\$/ha/mm)
Modelling
 (1959-2019)



Nitrogen
 □ 50
 ■ 90

System WUE (\$/ha/mm)

- Long term modelling: Low < 1.0; Often ~1.5; High > 2.0
- Experiments 2018-2023

	Condo	Urana	Wagga	Greene'pe
Lowest	0.8	1.2	0.7	1.3
Baseline	1.4	1.6	1.5	1.7
Highest	1.5	1.9	1.5	1.8
	C-W	Faba-C-W	C-W-B	Faba-C-W

Take-home messages



- System WUE (\$/ha/mm) → valuable, robust metric by capturing legacy effects of water & N; ~\$0.8-2.0/ha/mm



- Legume-C-W → highest WUE (2/4 sites), ROI, lower cereal disease, lower GHG → significant benefits to the system



- To have Legume-C-W work well → Solve soil acidity, choose right legume, and overcome practical challenges



Thank you

(2018-)

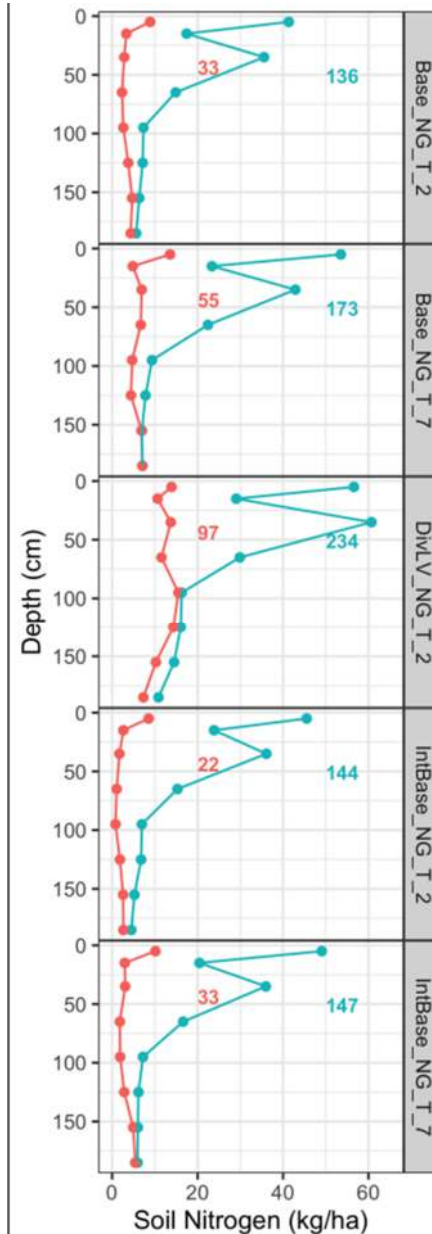


(2024-)



Greenethorpe: Avg 6-yr Soil Mineral Nitrogen (0-2m) prior to sowing canola (Mineralisation over summer)

● PostHarvest
● PreSowing



Post-Harvest Min N (kg/ha) Pre-sow Min N (kg/ha)

N2 33 **+100** 133

1.5-2t/ha

Baseline

Wheat 2 - Canola

Estimated canola yield with pre-sow mineral N concentration/treatment

N7 55 173

N2 97 **+137** 234

3t/ha

Diversified

Faba - Canola

N2 22 144

1.8 t/ha

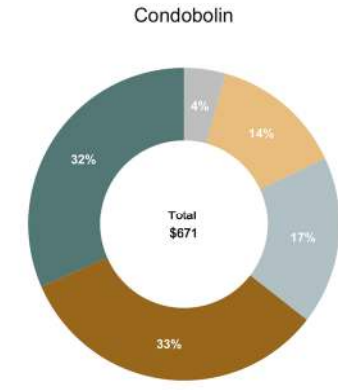
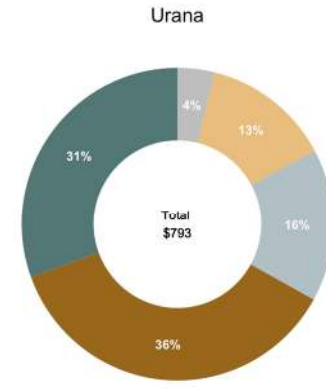
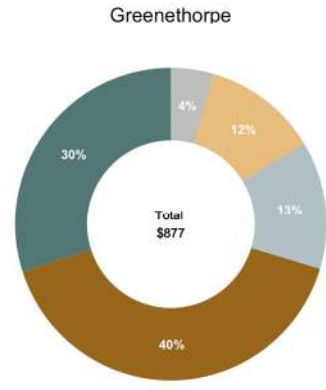
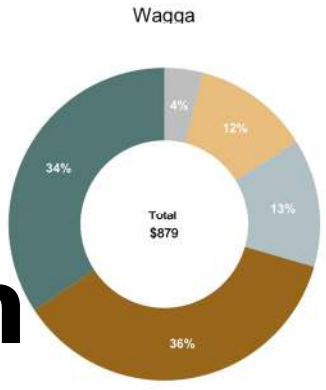
Intense Baseline

Wheat - Canola

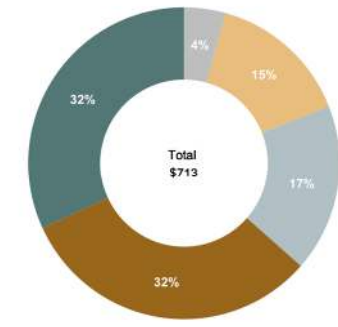
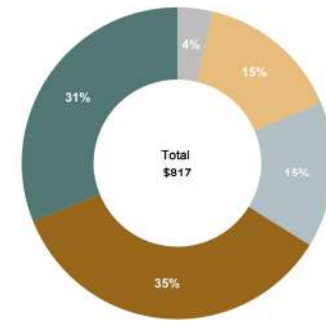
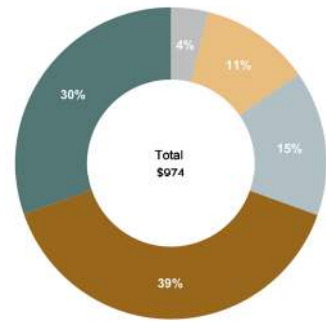
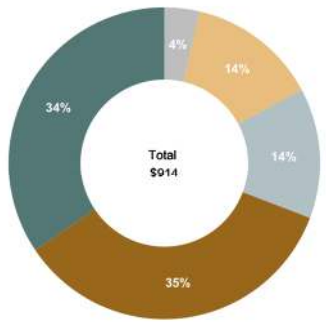
N7 33 147

Cost break down

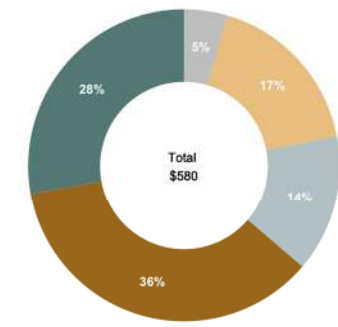
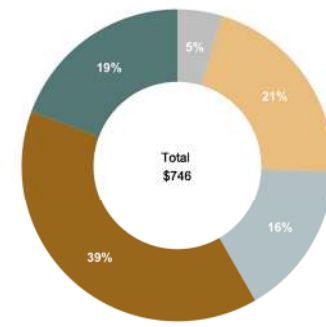
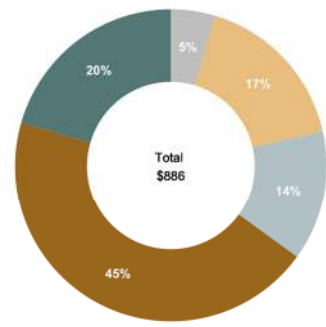
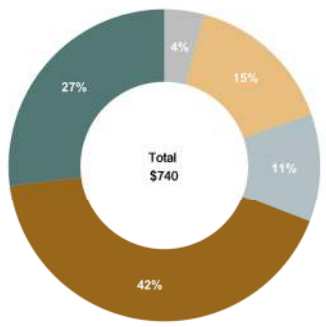
Base_NG_T_2 C-W-B(W)



IntBase_NG_T_2 C-W



DivLV_NG_T_2 C-W-Faba(Lup)

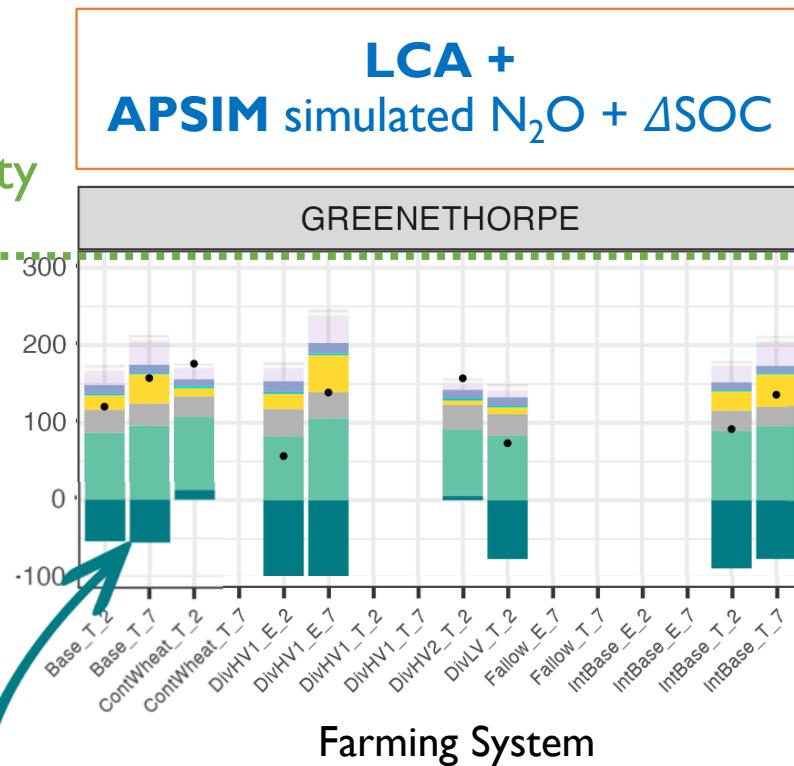


Fertiliser Chemical Harvest Sow Other

Low GHG emission intensity (kg CO₂eq / t yield)

(2018-2022 data)

Aus. grains sector
average GHG intensity
315 kg CO₂eq / t



N₂O →
a major contributor to
total GHG

- Modelling suggested C sequestration offset a large portion of GHG emissions

Waiting for measured SOC data to verify...

Yield predictions & N budgeting: Early ungrazed wheat

