

Koolstofvoetspoor: Volhoudbare gewasproductie met vee en weidings



Herkouersdag

Prof Pieter Swanepoel



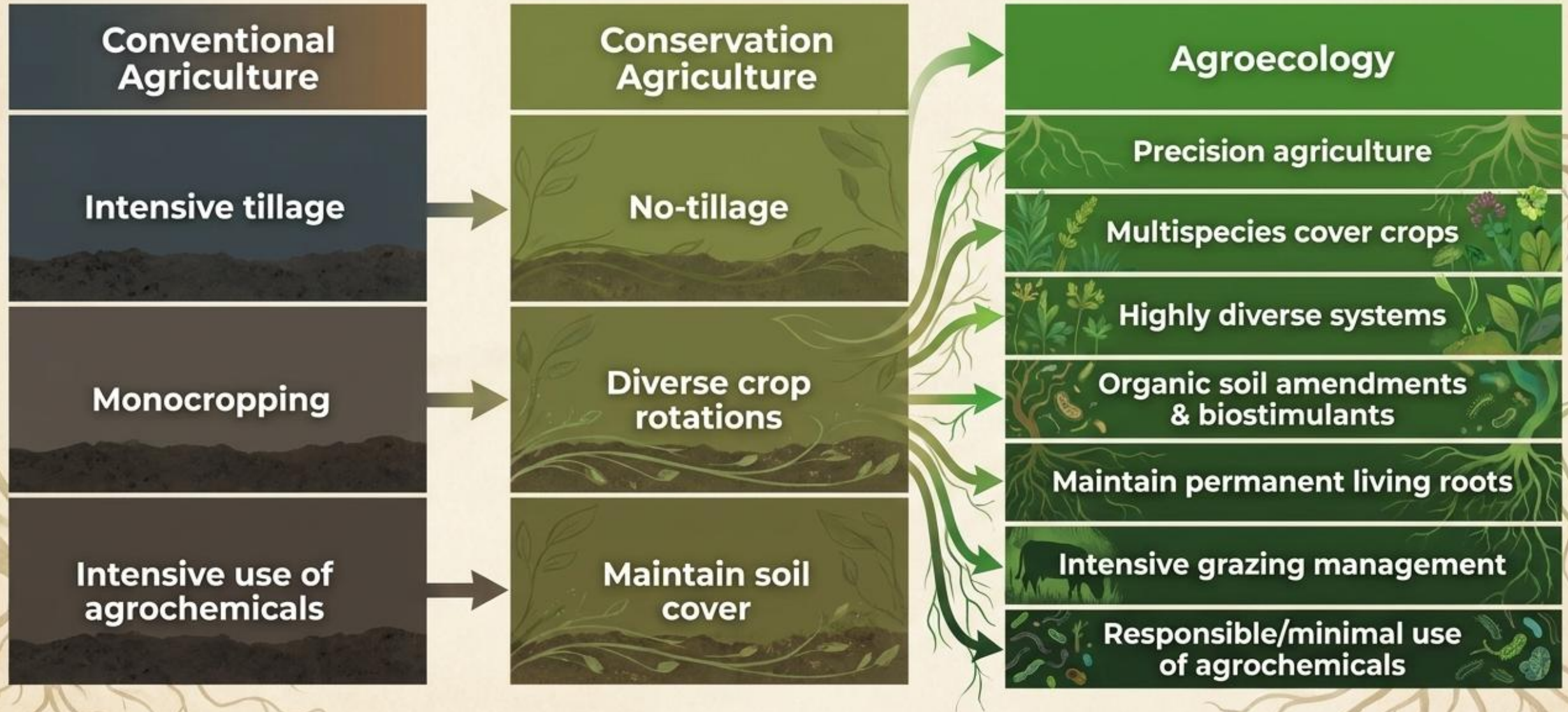
OVERBERG

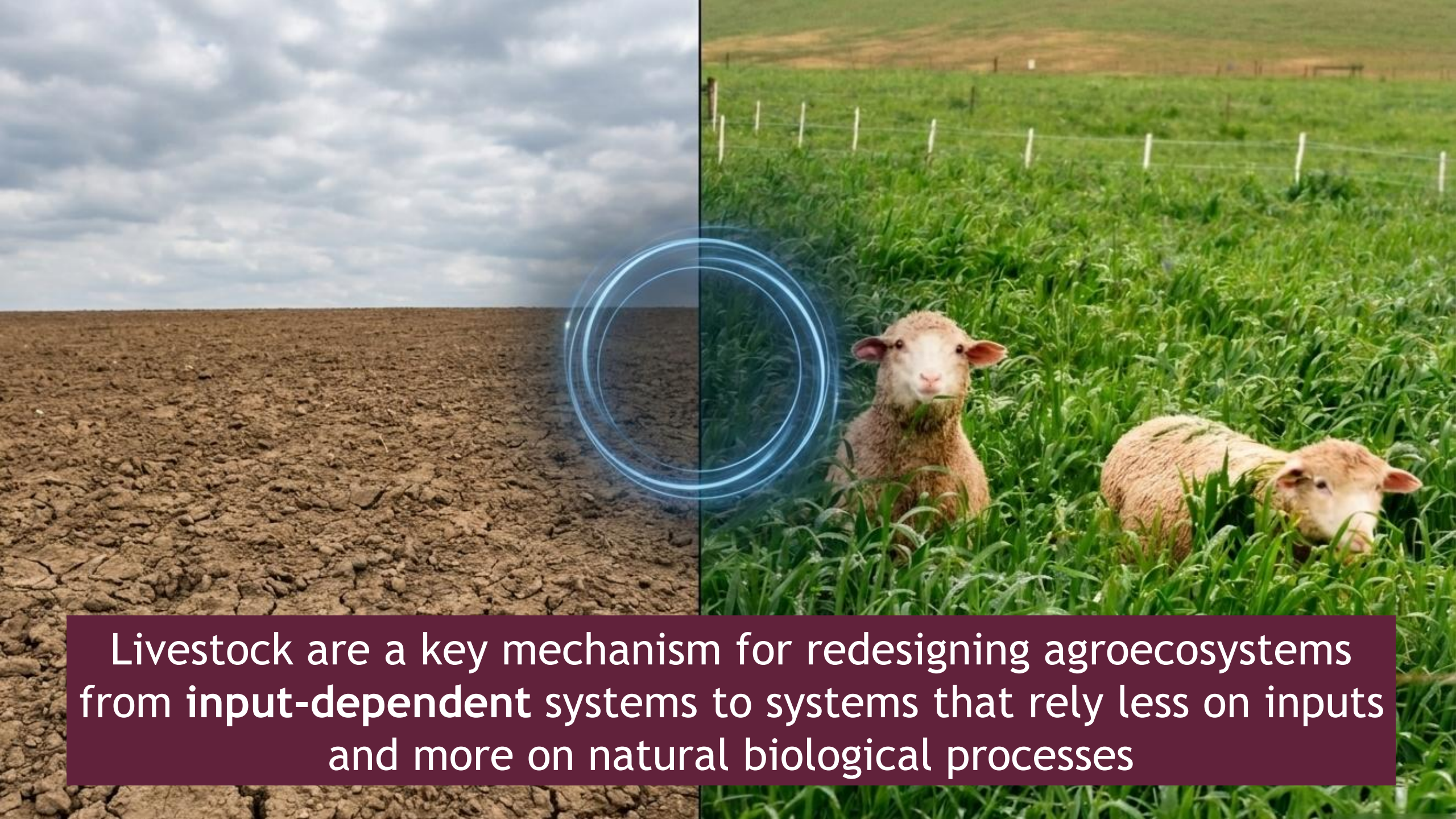
Climate-Smart Farming: Using Livestock and Pastures to Improve Sustainability

Pieter Swanepoel
Department of Agronomy



The evolutionary trajectory of Western Cape cropping systems





Livestock are a key mechanism for redesigning agroecosystems from **input-dependent** systems to systems that rely less on inputs and more on natural biological processes

Livestock do more than produce emissions



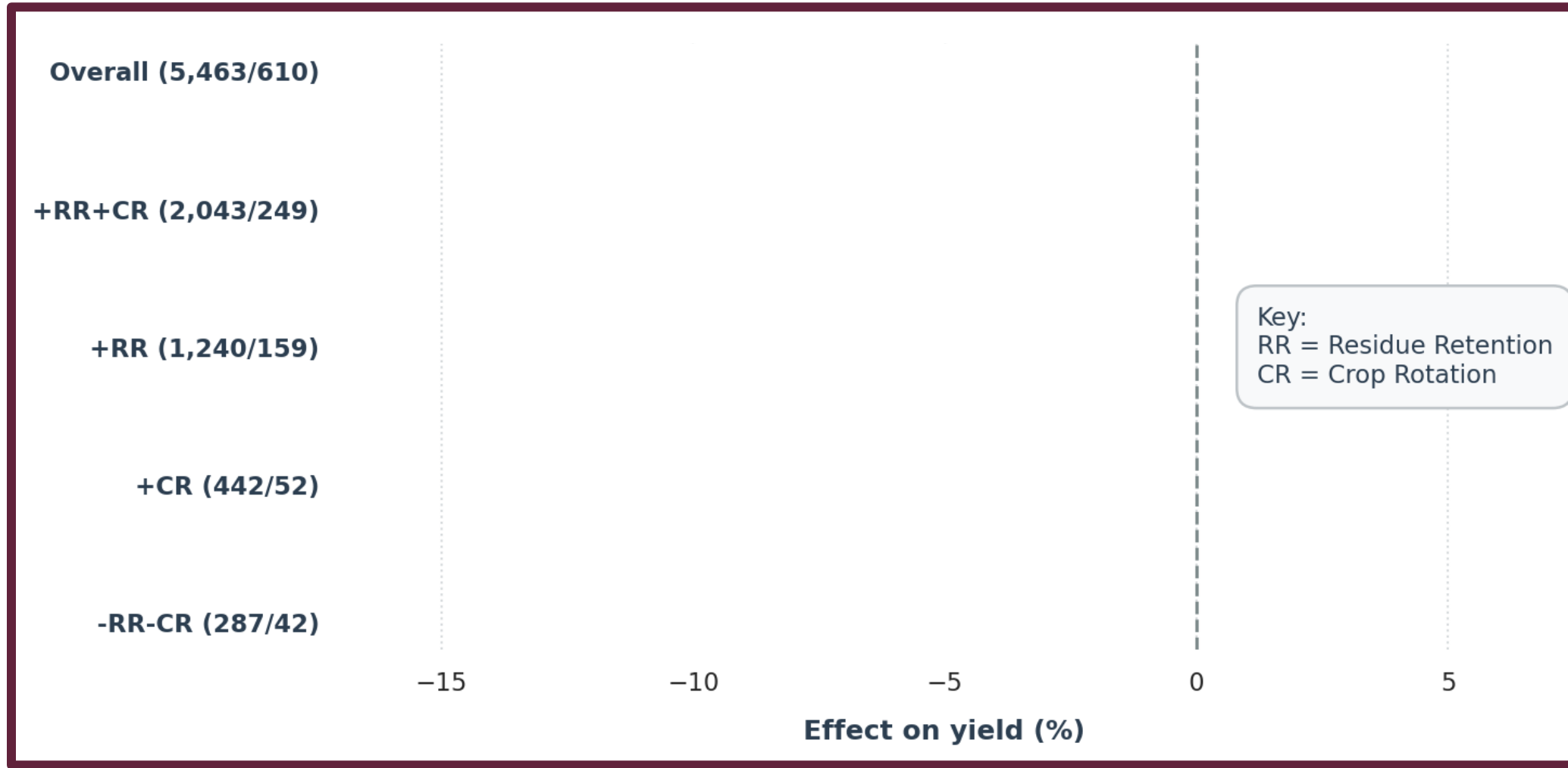
- Allow integration of legumes as N fixers
 - Replace synthetic N fertilisers
- Diversify systems
 - Breaks pest and disease cycles = lower agrochemical inputs
 - Grazing reduces herbicide requirements
 - Grazing reduces mechanical interventions
- Manure feeds soil biology
- Faster nutrient cycling

Livestock accelerate biological carbon cycling

Resilience and yield: The theory from international literature

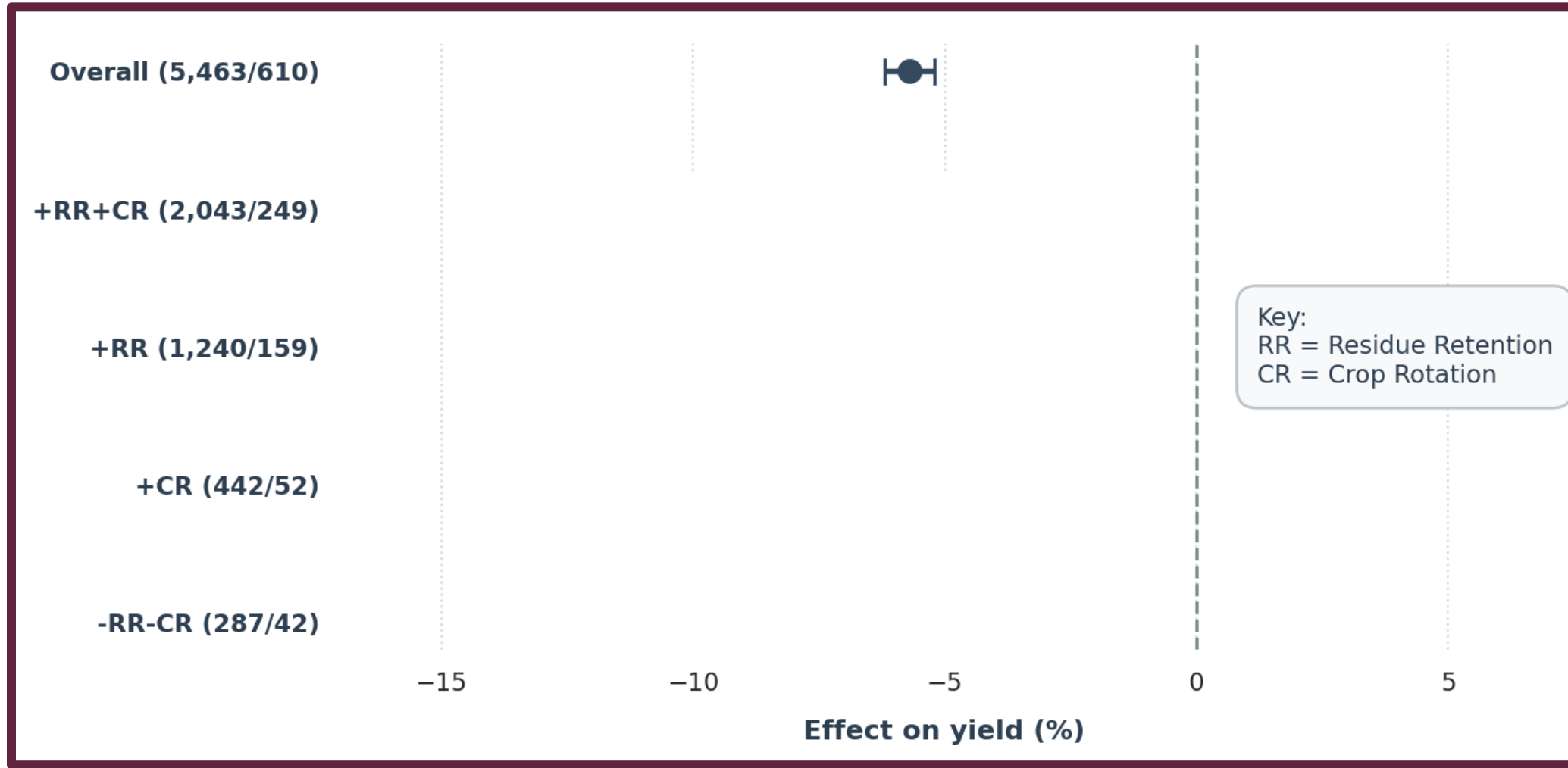


No-tillage vs Conventional Agriculture



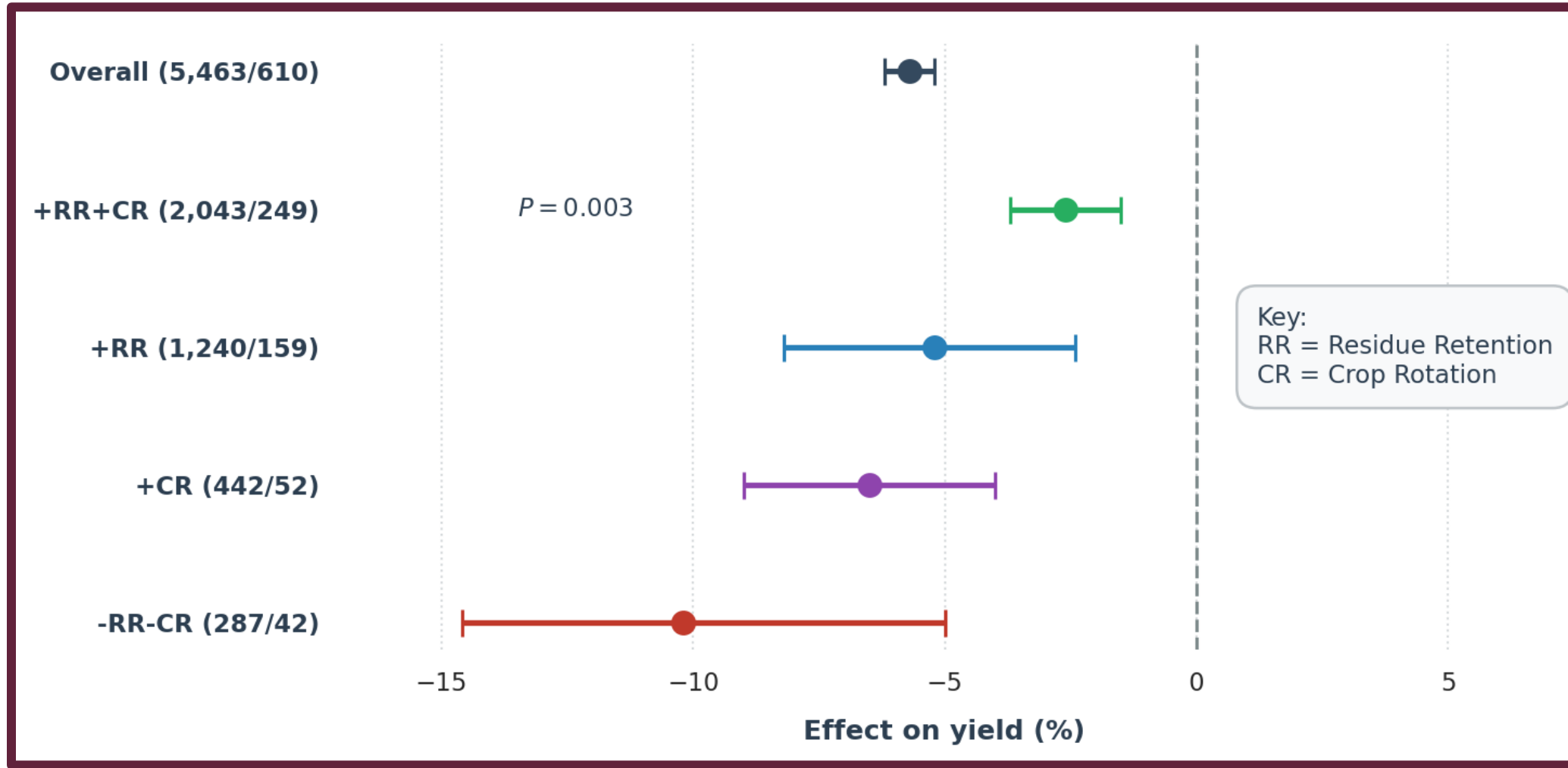
Pittelkow et al. 2015

No-tillage vs Conventional Agriculture

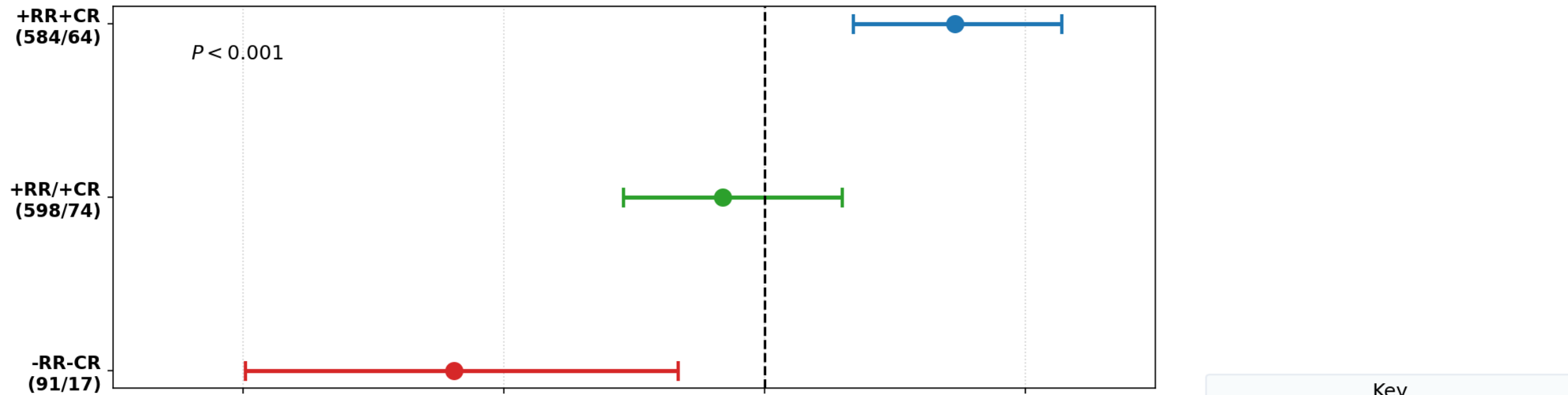
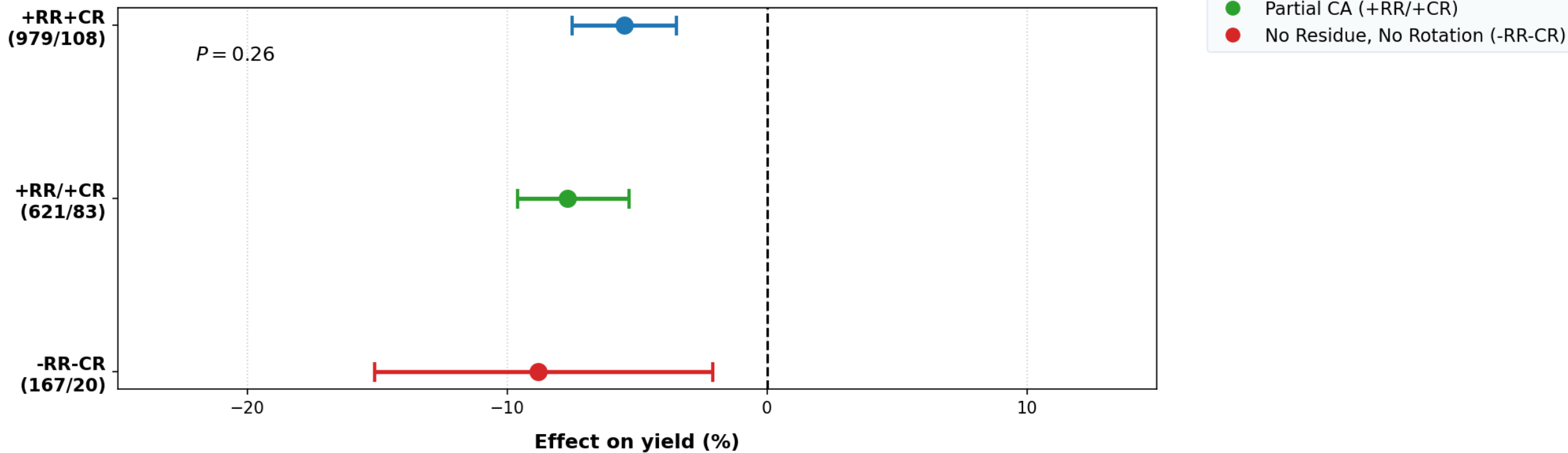


Pittelkow et al. 2015

No-tillage vs Conventional Agriculture

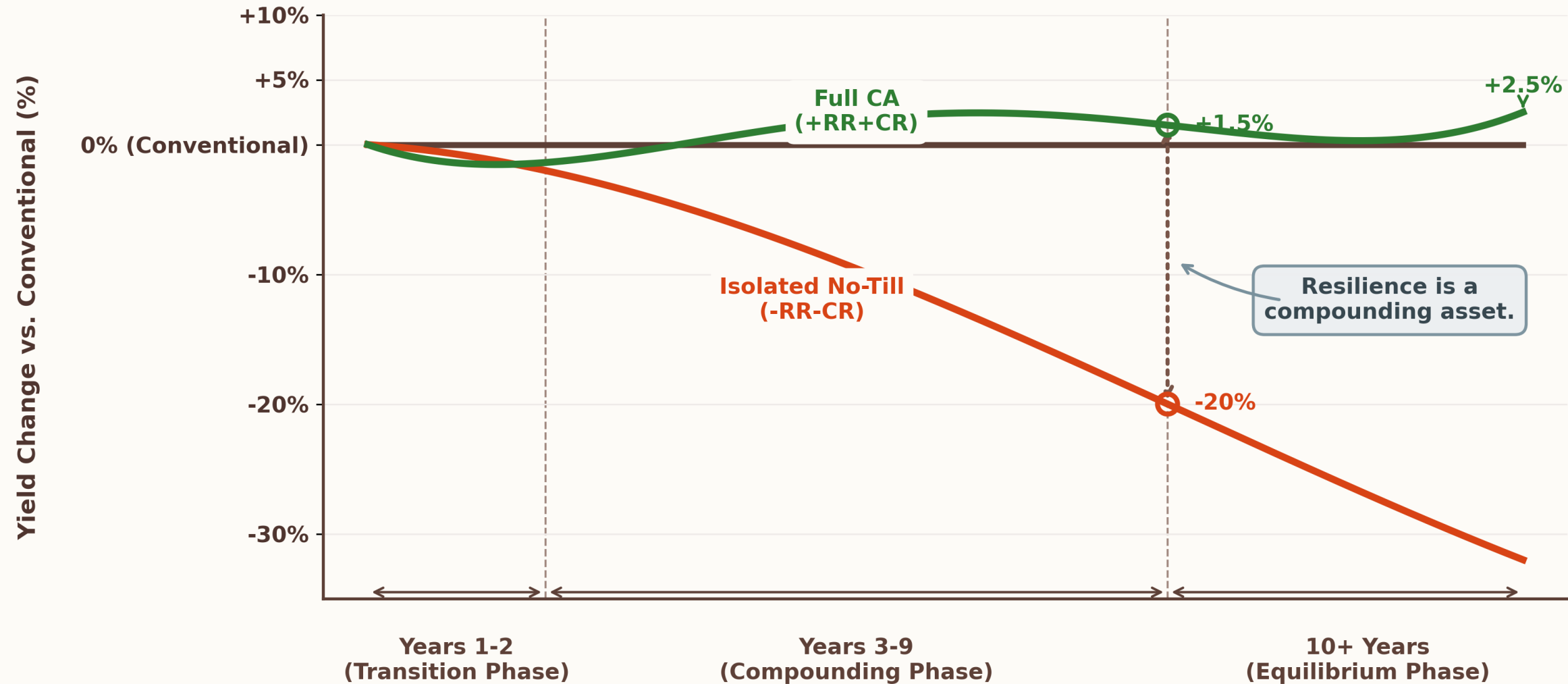


Pittelkow et al. 2015

a Dry**b Humid**

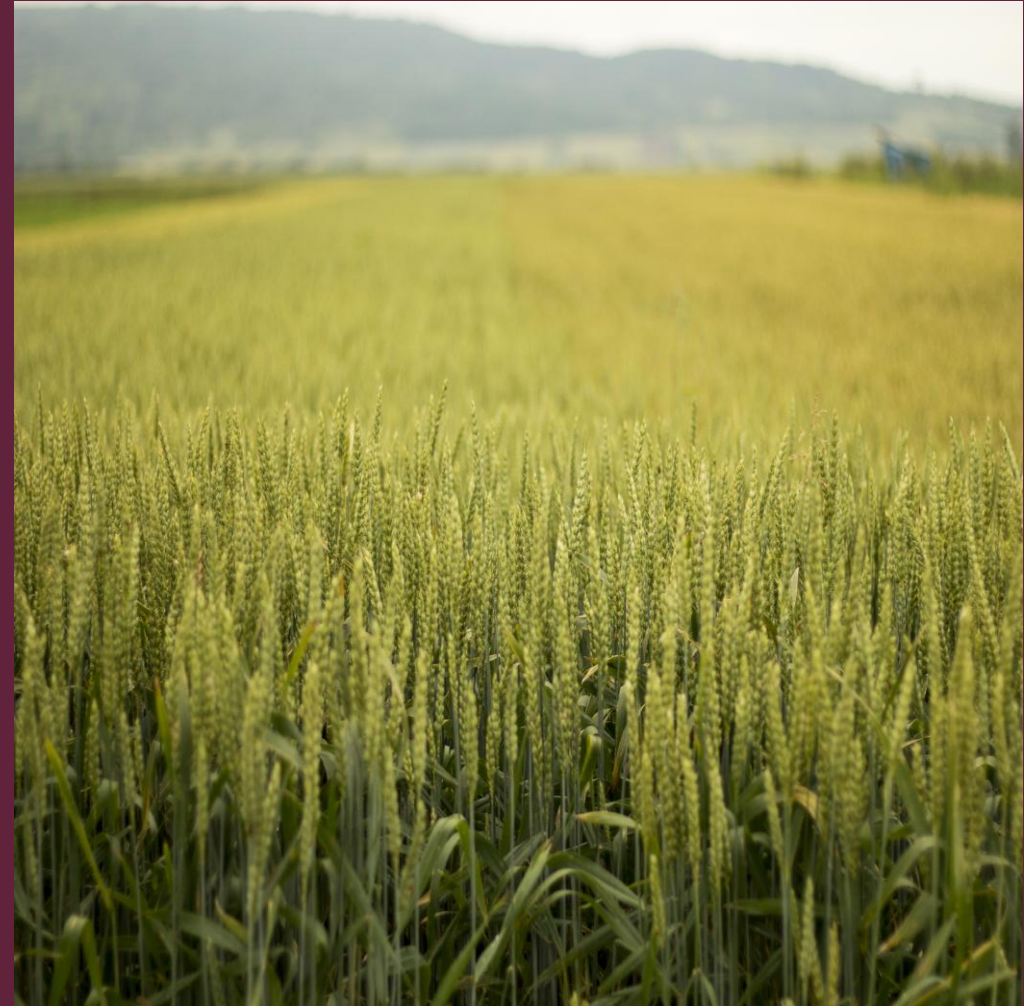
The Resilience Dividend in Conservation Agriculture

After a decade of consistent biological management, the system reaches a stable yield equilibrium.
Full Conservation Agriculture neutralises the initial yield penalty entirely, whereas isolated no-till leads to structural decline.



Resilience and yield:

Local evidence



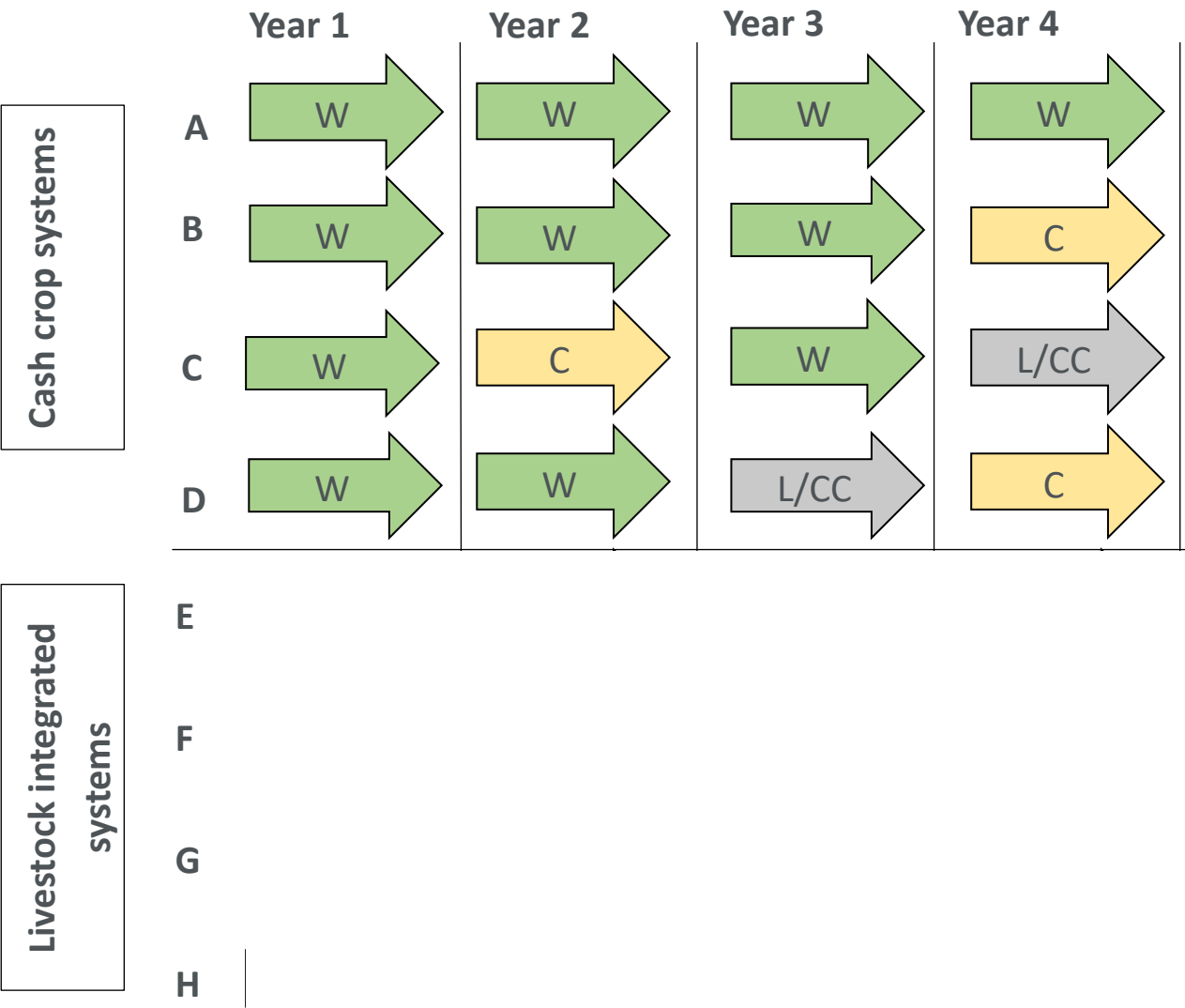
Langgewens long-term experiment



Western Cape
Government
FOR YOU



Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT



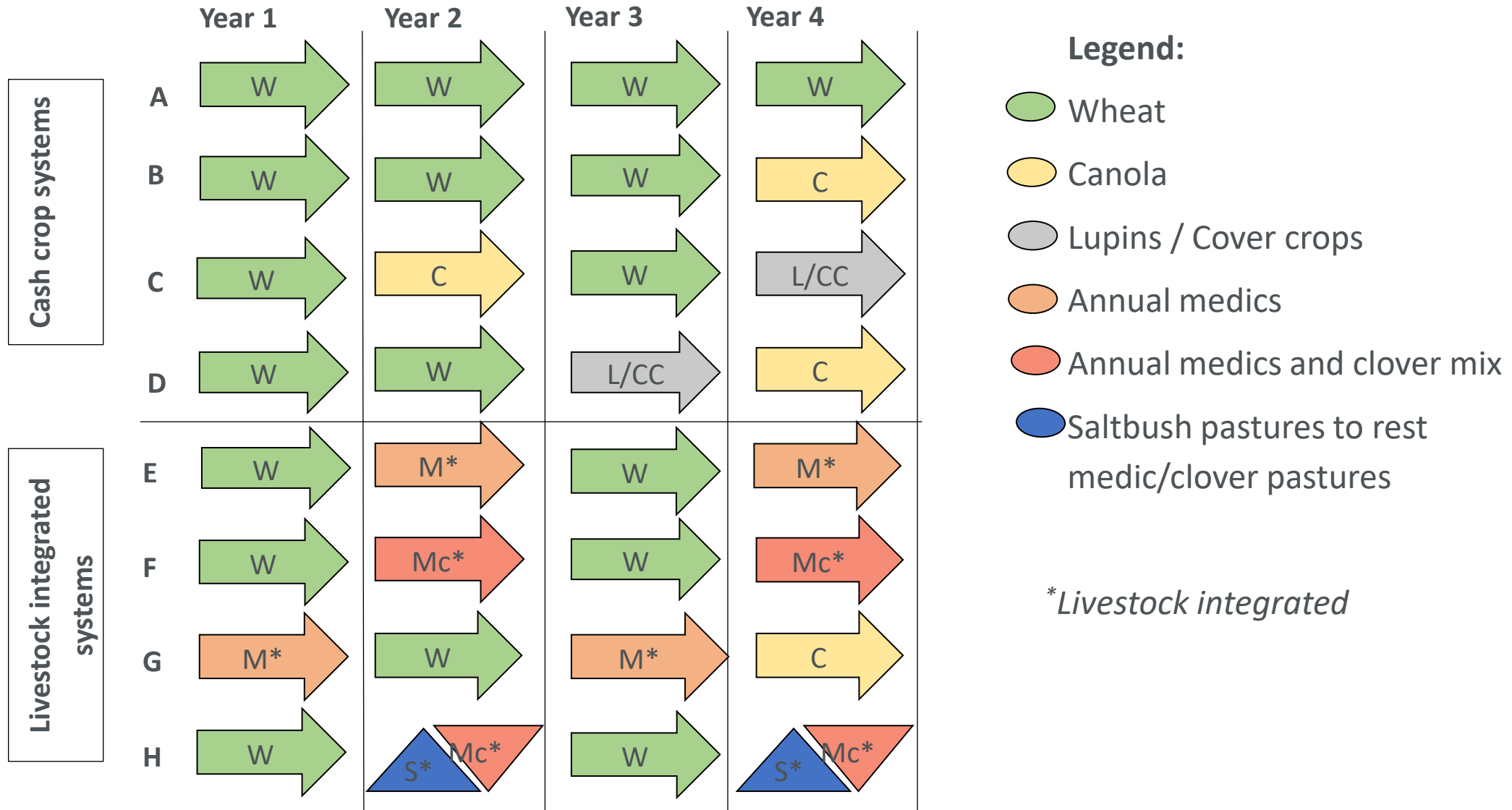
- Legend:
- Wheat
 - Canola
 - Lupins / Cover crops
 - Annual medics
 - Annual medics and clover mix
 - Saltbush pastures to rest medic/clover pastures

**Livestock integrated*

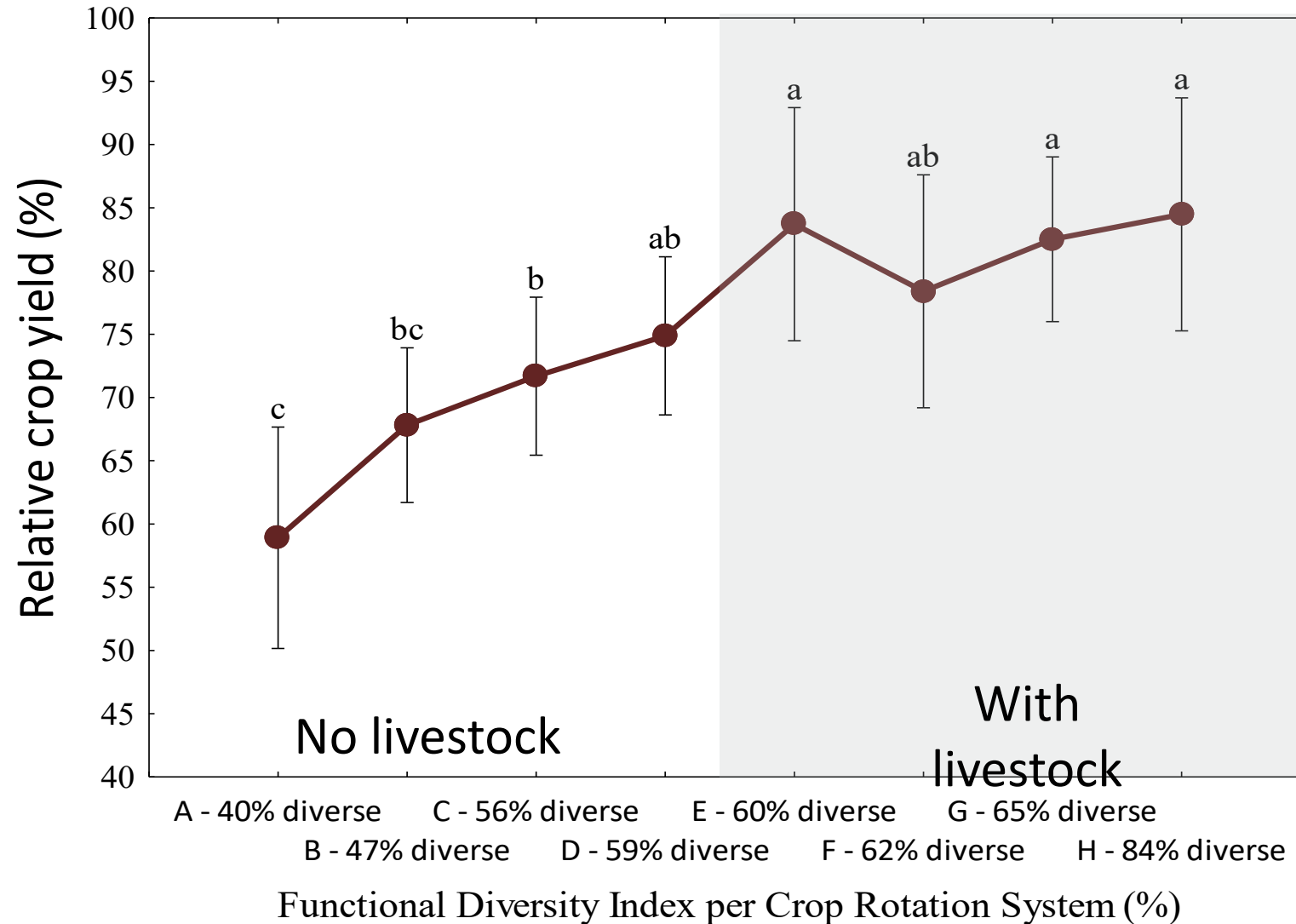
Langgewens long-term experiment



Western Cape
Government
FOR YOU



Long-term (20-year) crop yields - Swartland



Reduced reliance on agrochemicals



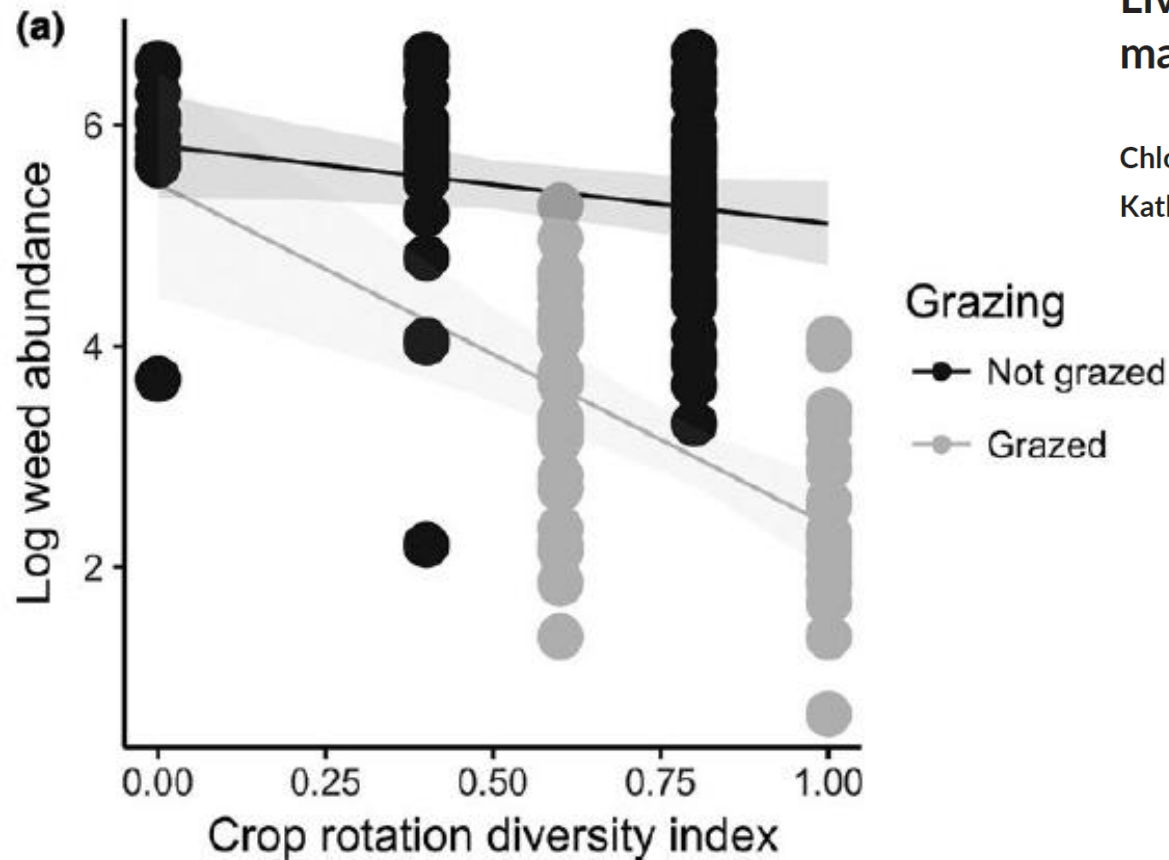
Livestock reduces weeds

RESEARCH ARTICLE

Journal of Applied Ecology 

Livestock in diverse cropping systems improve weed management and sustain yields whilst reducing inputs

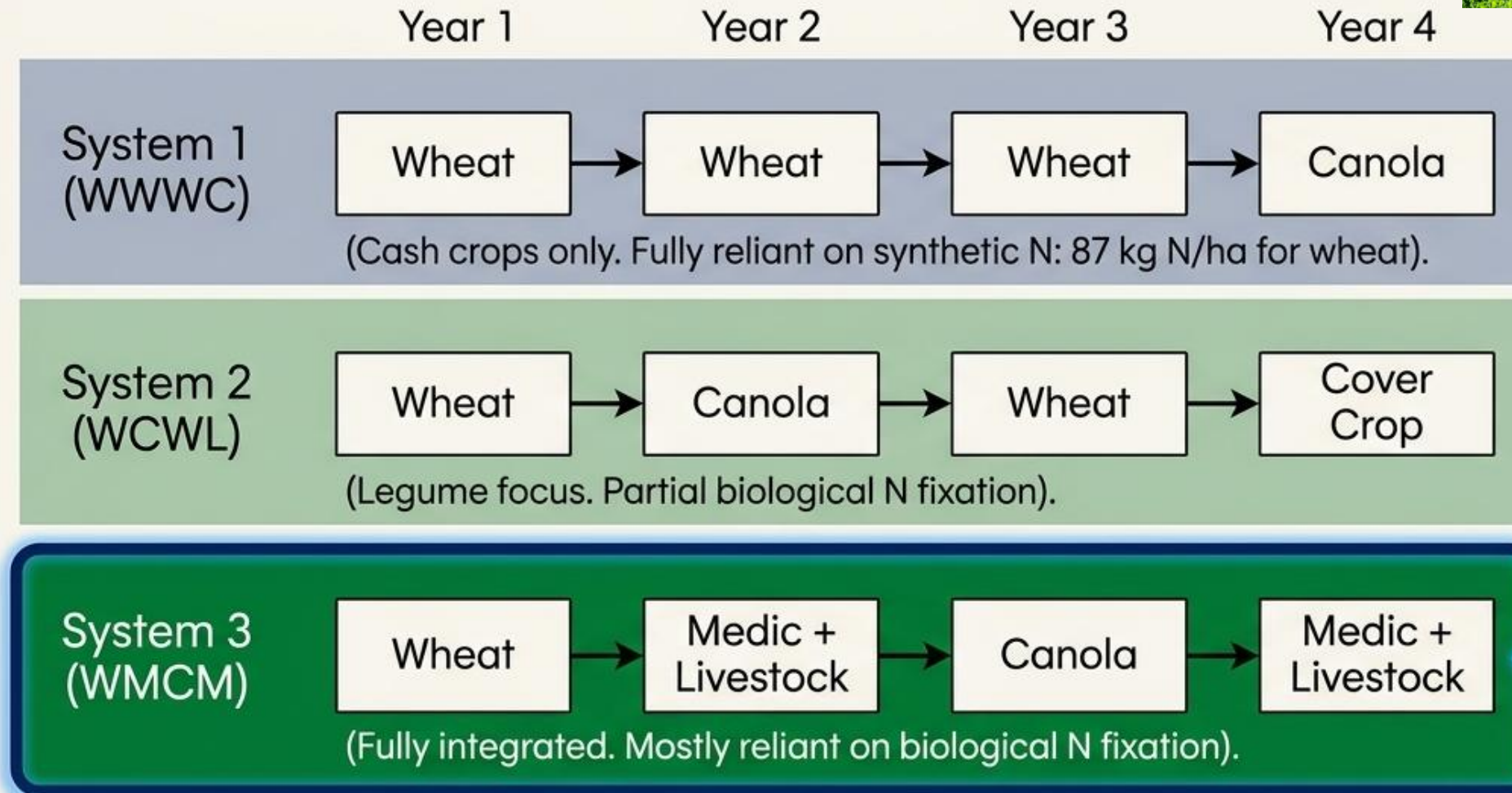
Chloe MacLaren¹  | Jonathan Storkey²  | Johann Strauss³ | Pieter Swanepoel⁴  | Katharina Dehnen-Schmutz¹ 



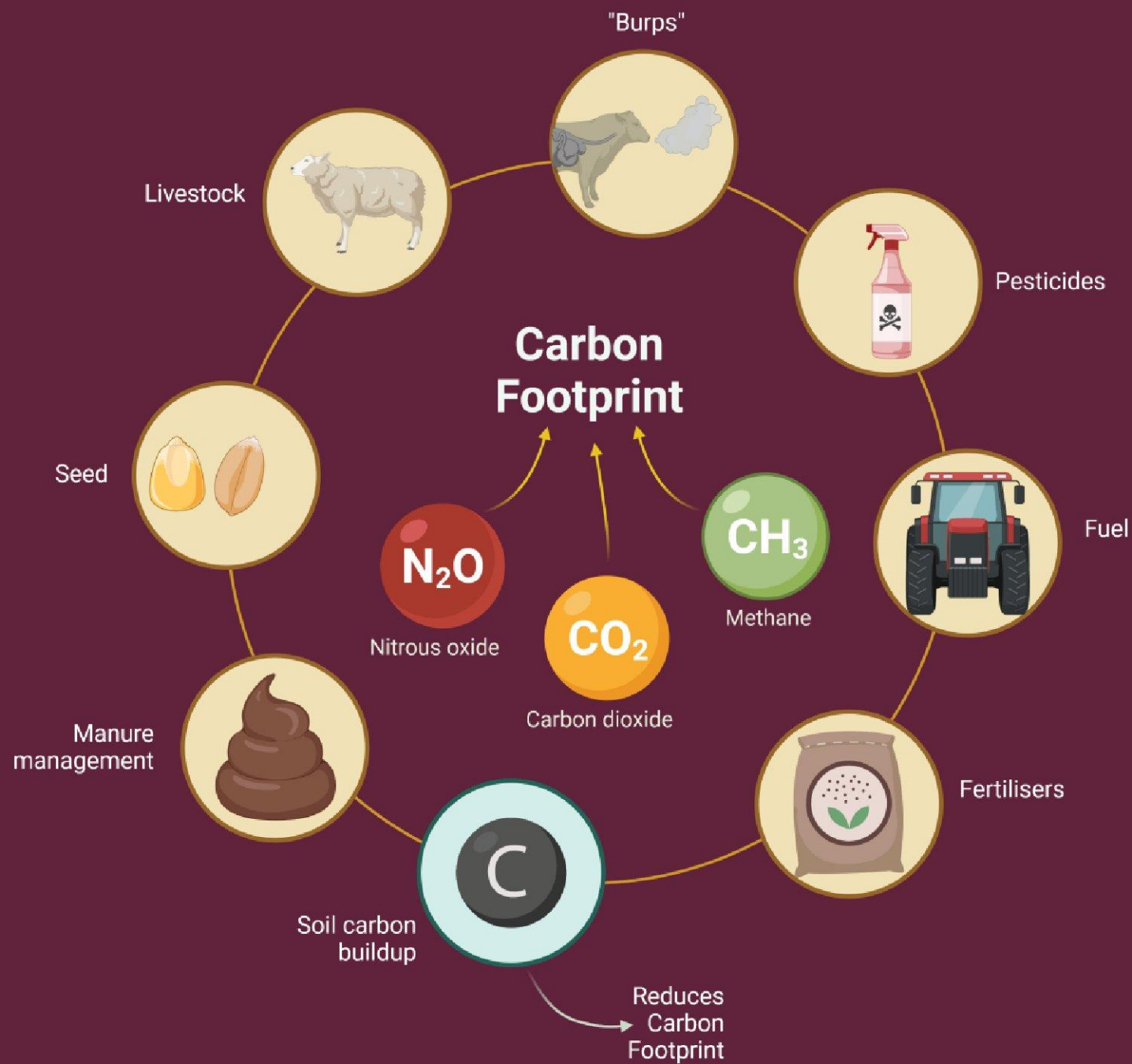
Reduced
environmental impact
=
More efficient farming



Testing the Redesign: 4-Year Rotation Models

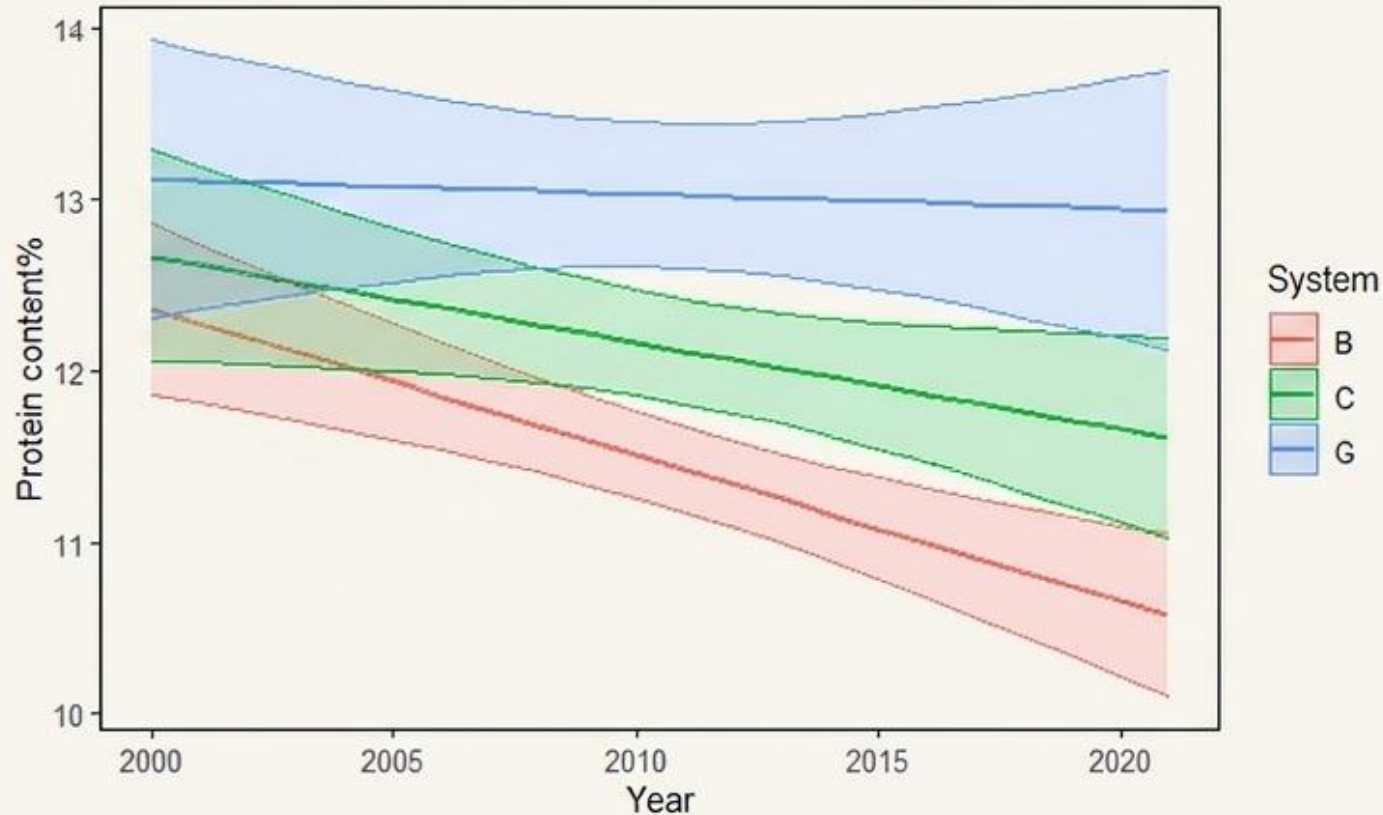


The Ultimate
Test of the
Circular
Carbon Flow
Hypothesis.



The Output: Enhanced Production & Quality

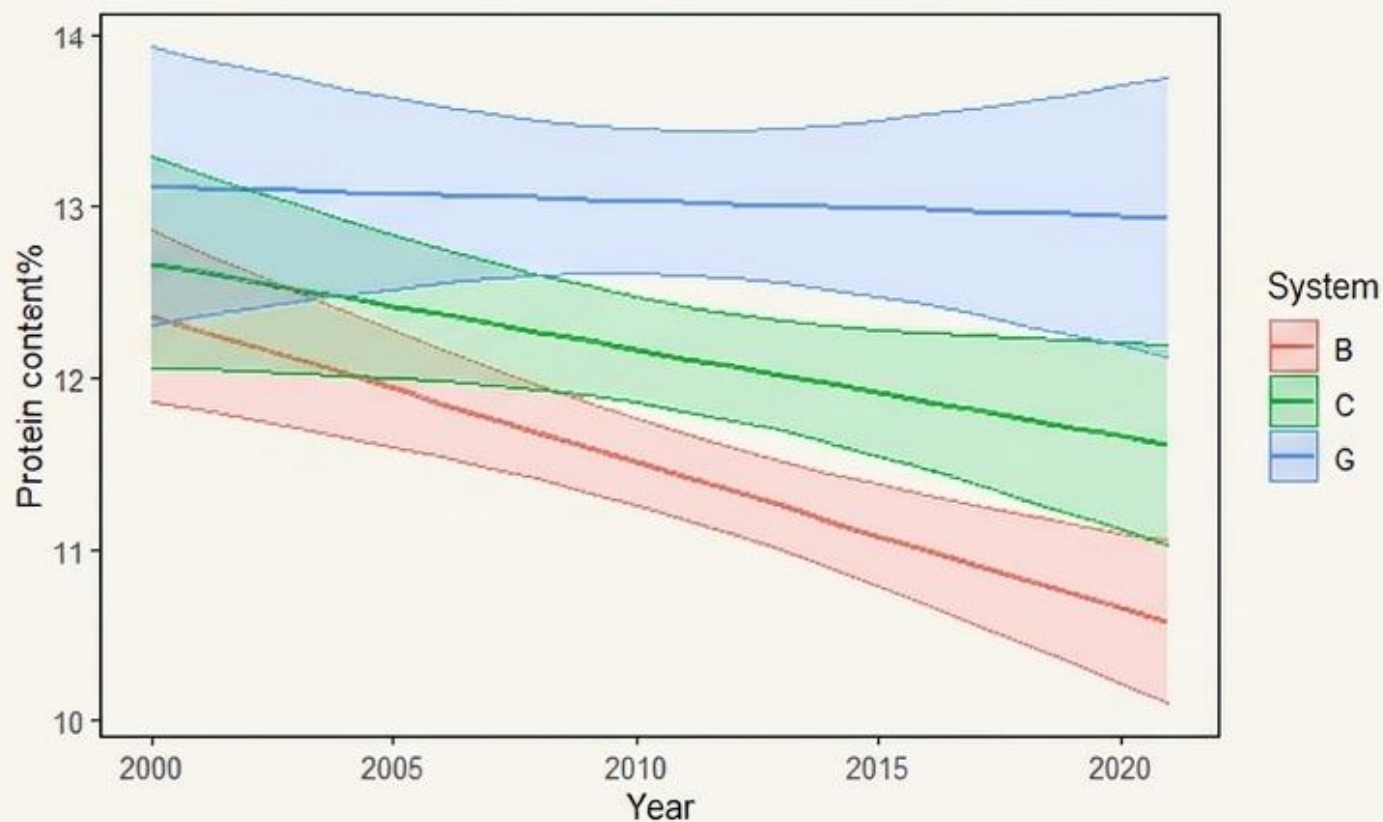
Leguminous cover crops significantly and sustainably increased wheat grain protein content over two decades.



Yield Synergy: Cash crops from integrated livestock/legume rotations consistently outperformed the continuous cash-crop system in total yield and biomass.

The Output: Enhanced Production & Quality

Leguminous cover crops significantly and sustainably increased wheat grain protein content over two decades.



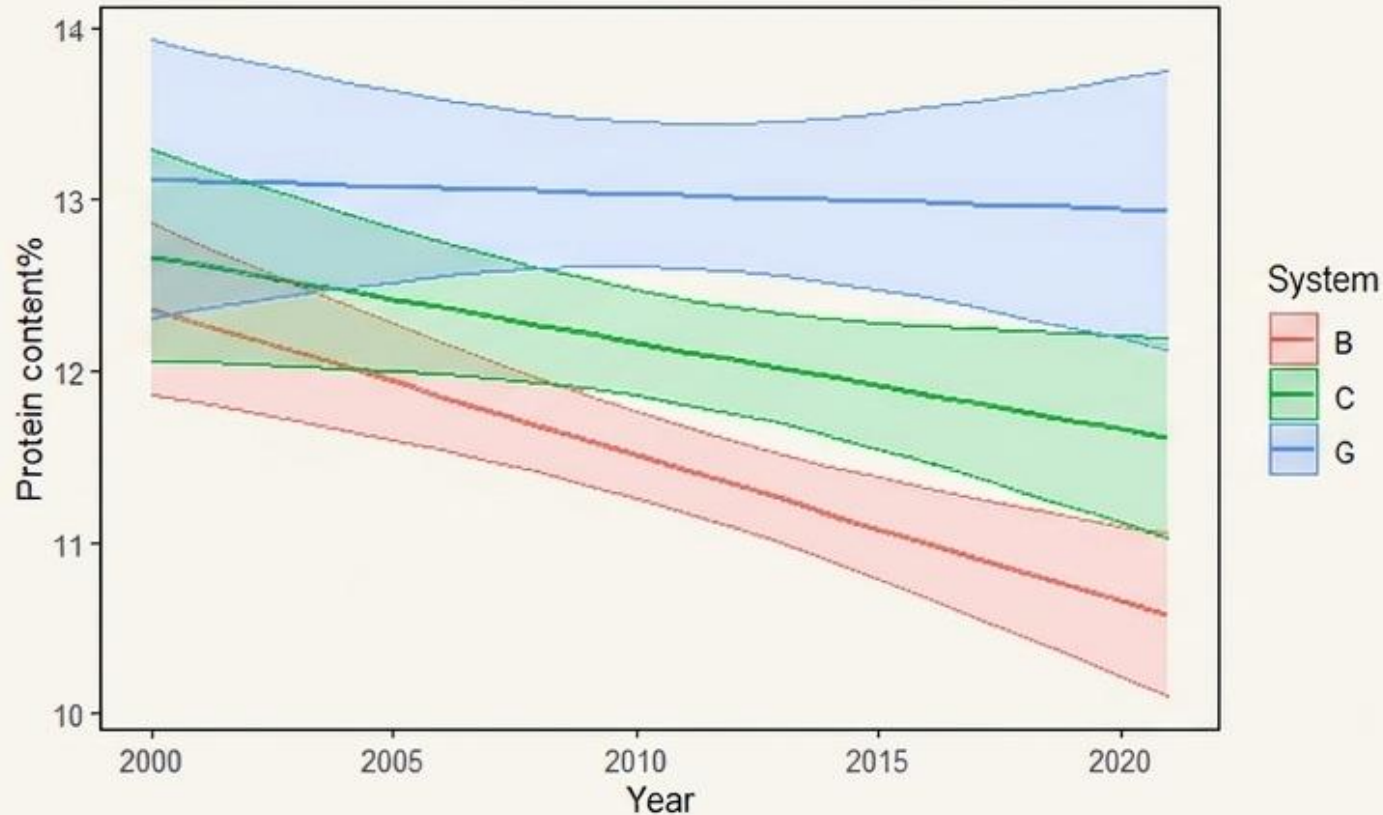
Yield Synergy: Cash crops from integrated livestock/legume rotations consistently outperformed the continuous cash-crop system in total yield and biomass.



Quality Proof: >90% of wheat harvested from integrated systems (WMCM, WCWL) met high-value bread grade.

The Output: Enhanced Production & Quality

Leguminous cover crops significantly and sustainably increased wheat grain protein content over two decades.



Yield Synergy: Cash crops from integrated livestock/legume rotations consistently outperformed the continuous cash-crop system in total yield and biomass.



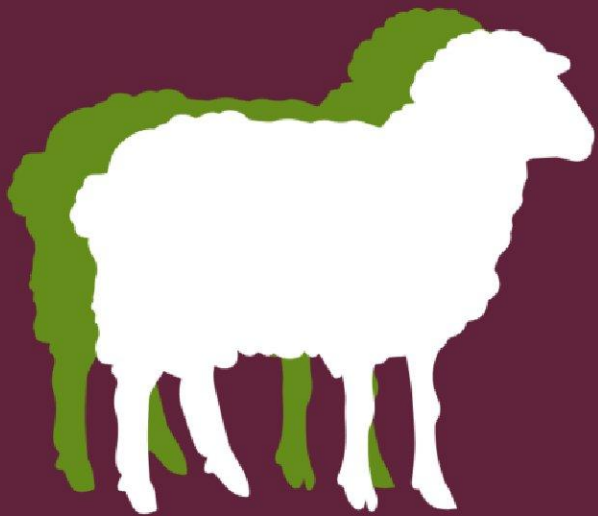
Quality Proof: >90% of wheat harvested from integrated systems (WMCM, WCWL) met high-value bread grade.



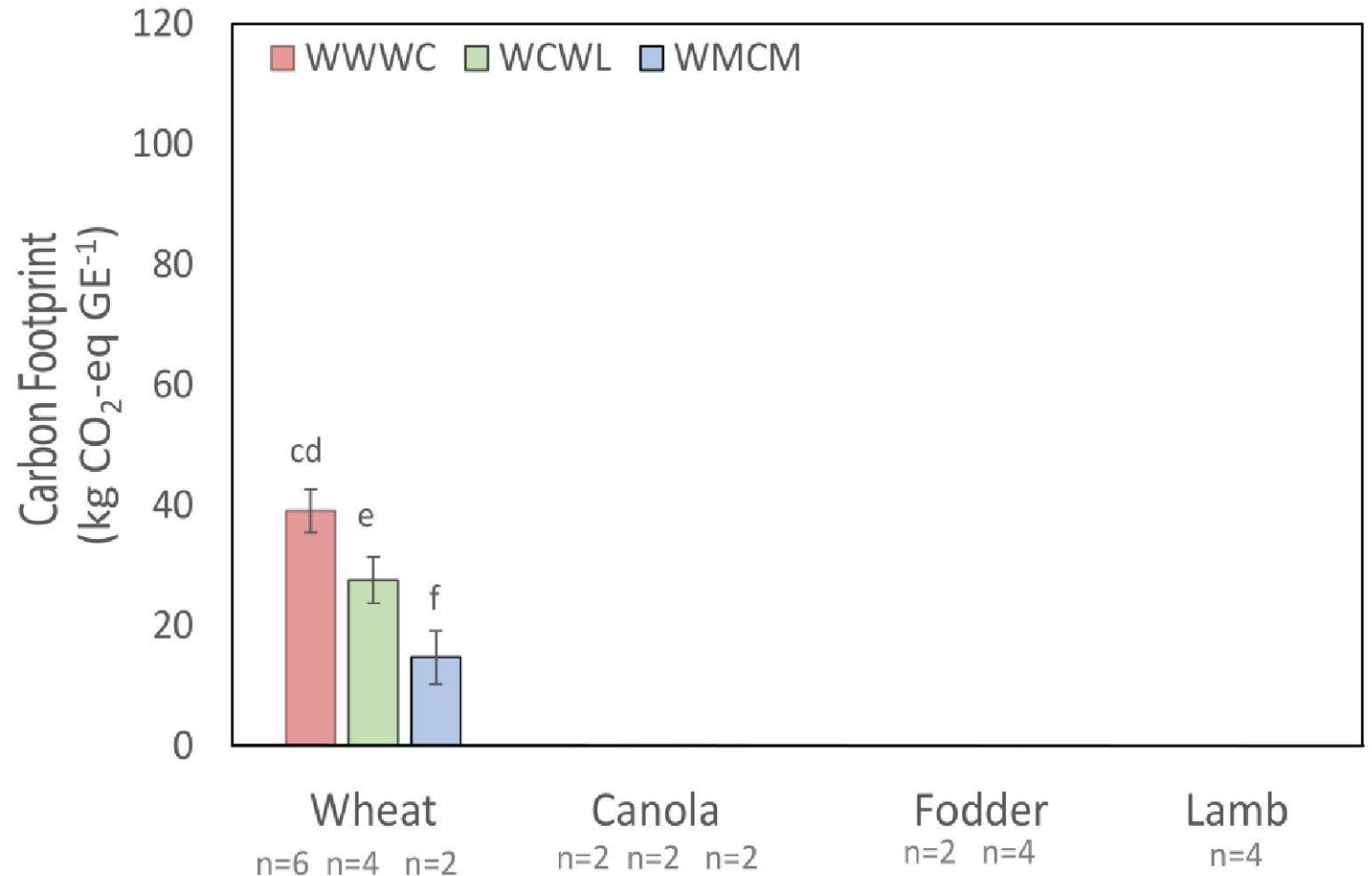
Baseline: Only 75% of wheat from the synthetic WWWC system achieved bread grade.

Local evidence

Carbon Footprint of
different agricultural
commodities

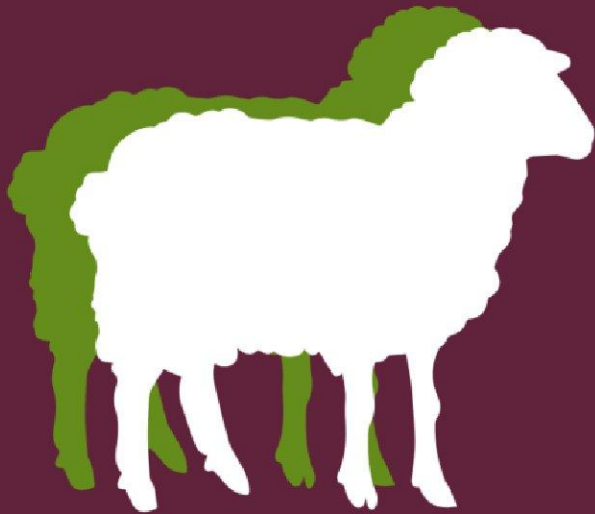


L. Matthews, 2022

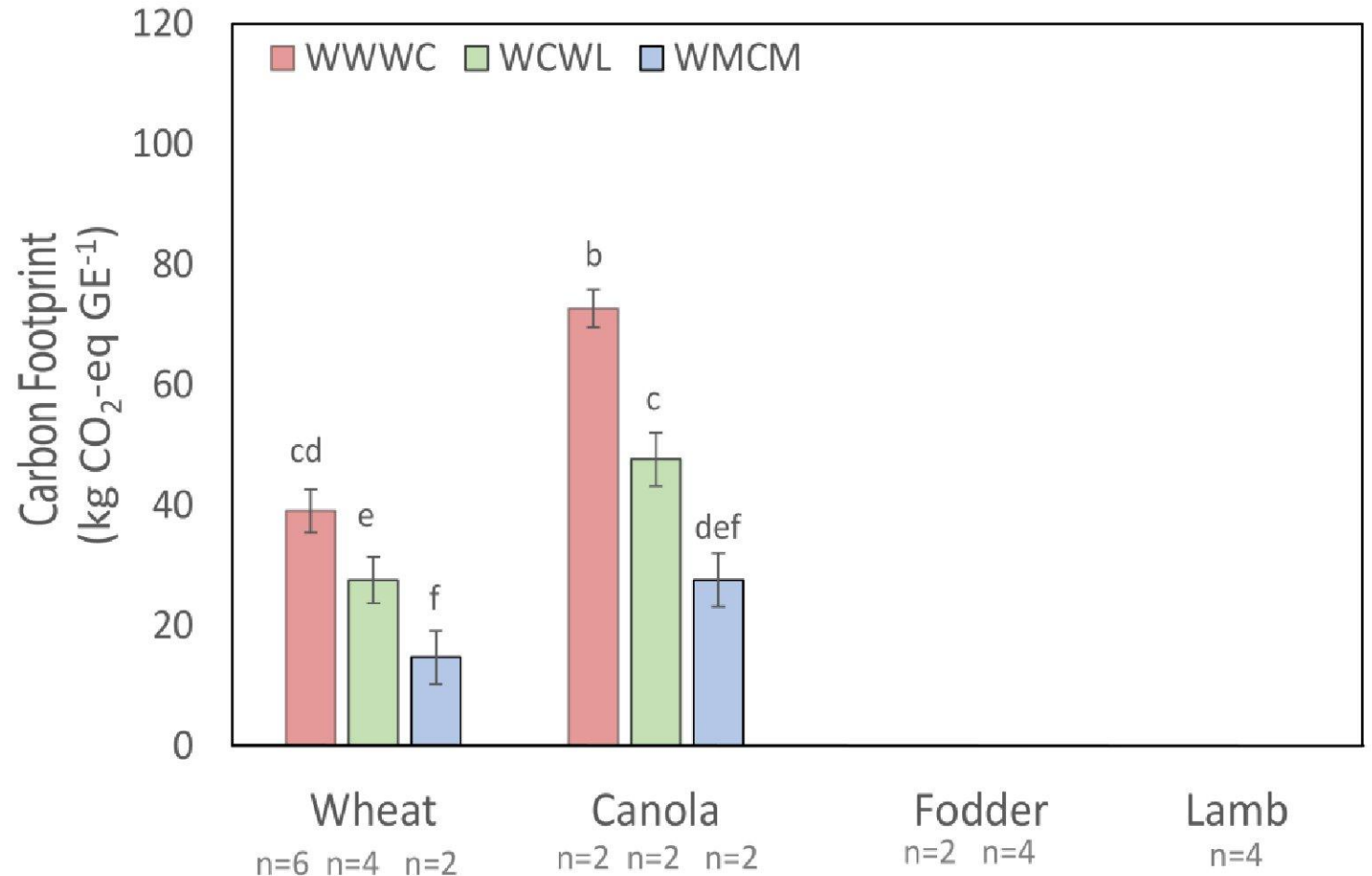


Local evidence

Carbon Footprint of
different agricultural
commodities



L. Matthews, 2022

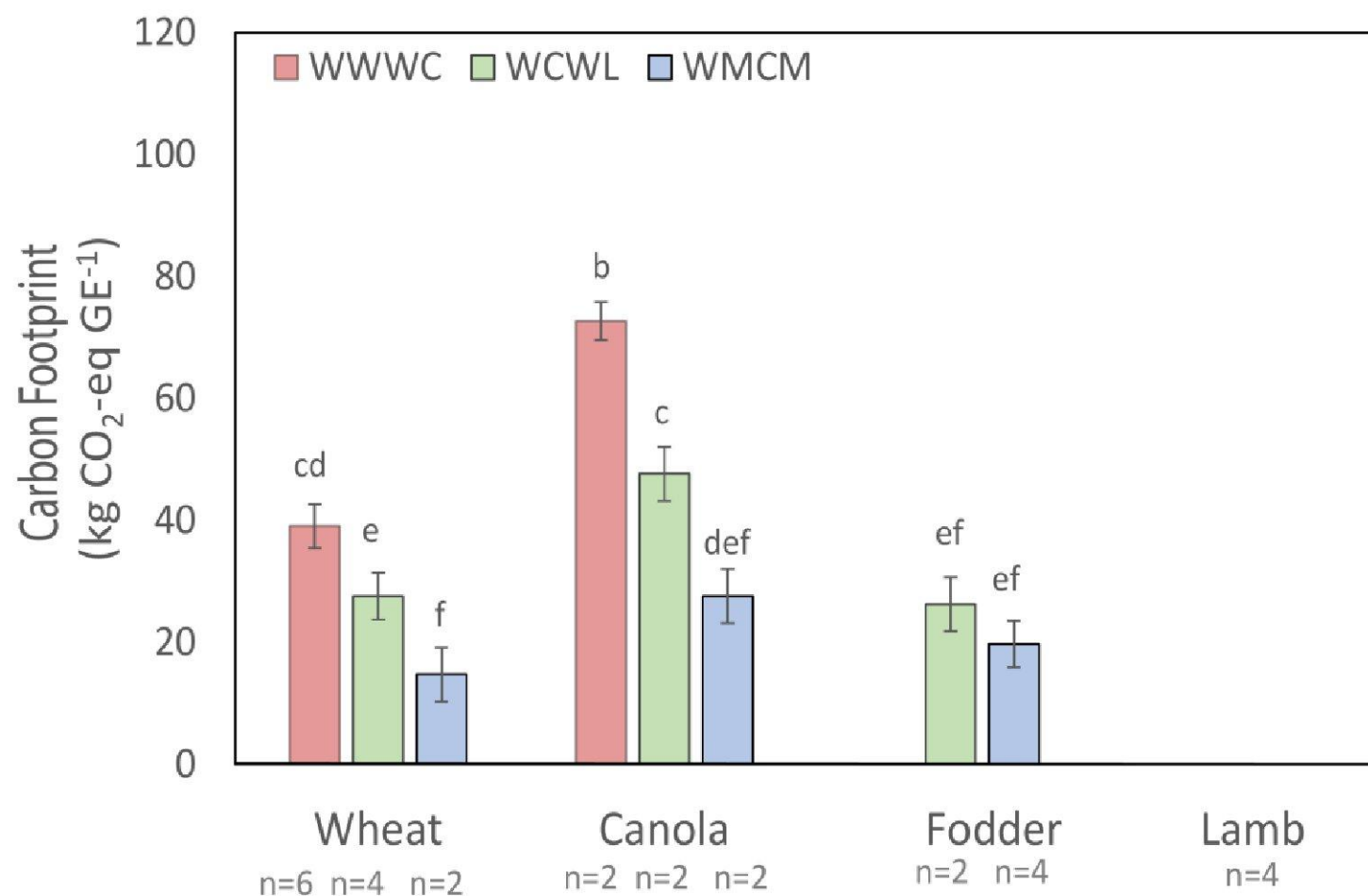


Local evidence

Carbon Footprint of
different agricultural
commodities

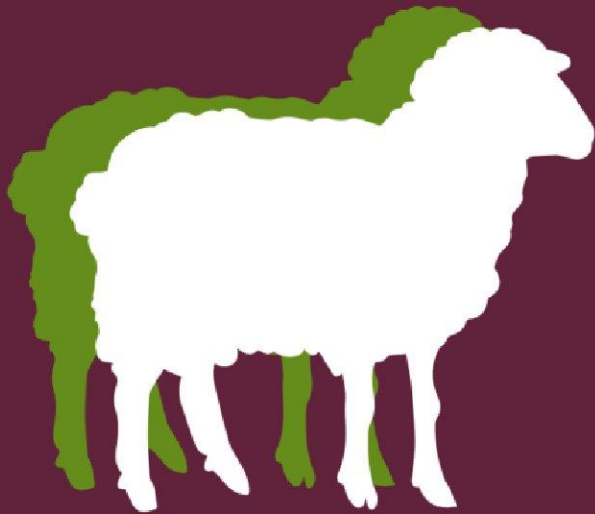


L. Matthews, 2022

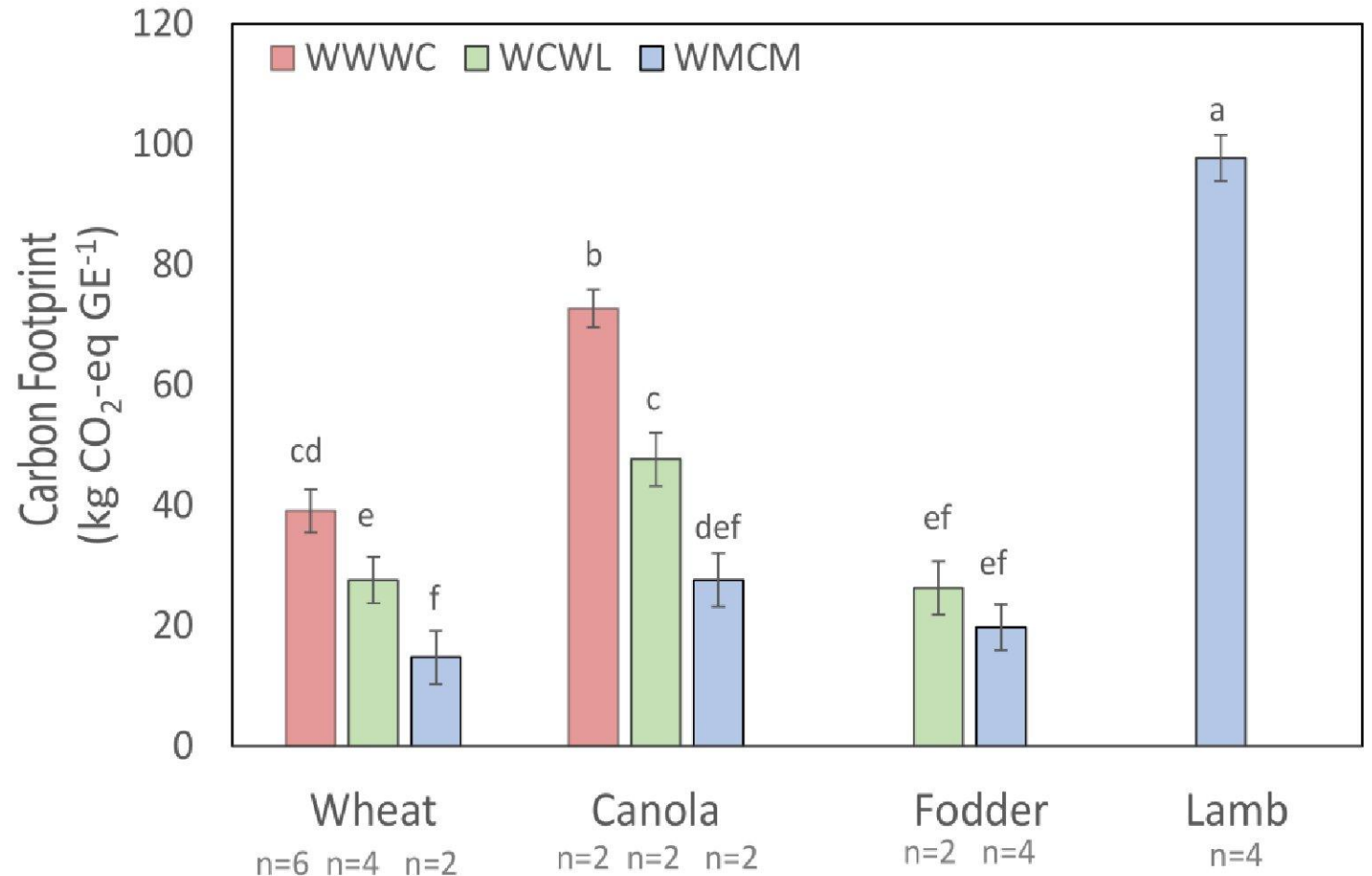


Local evidence

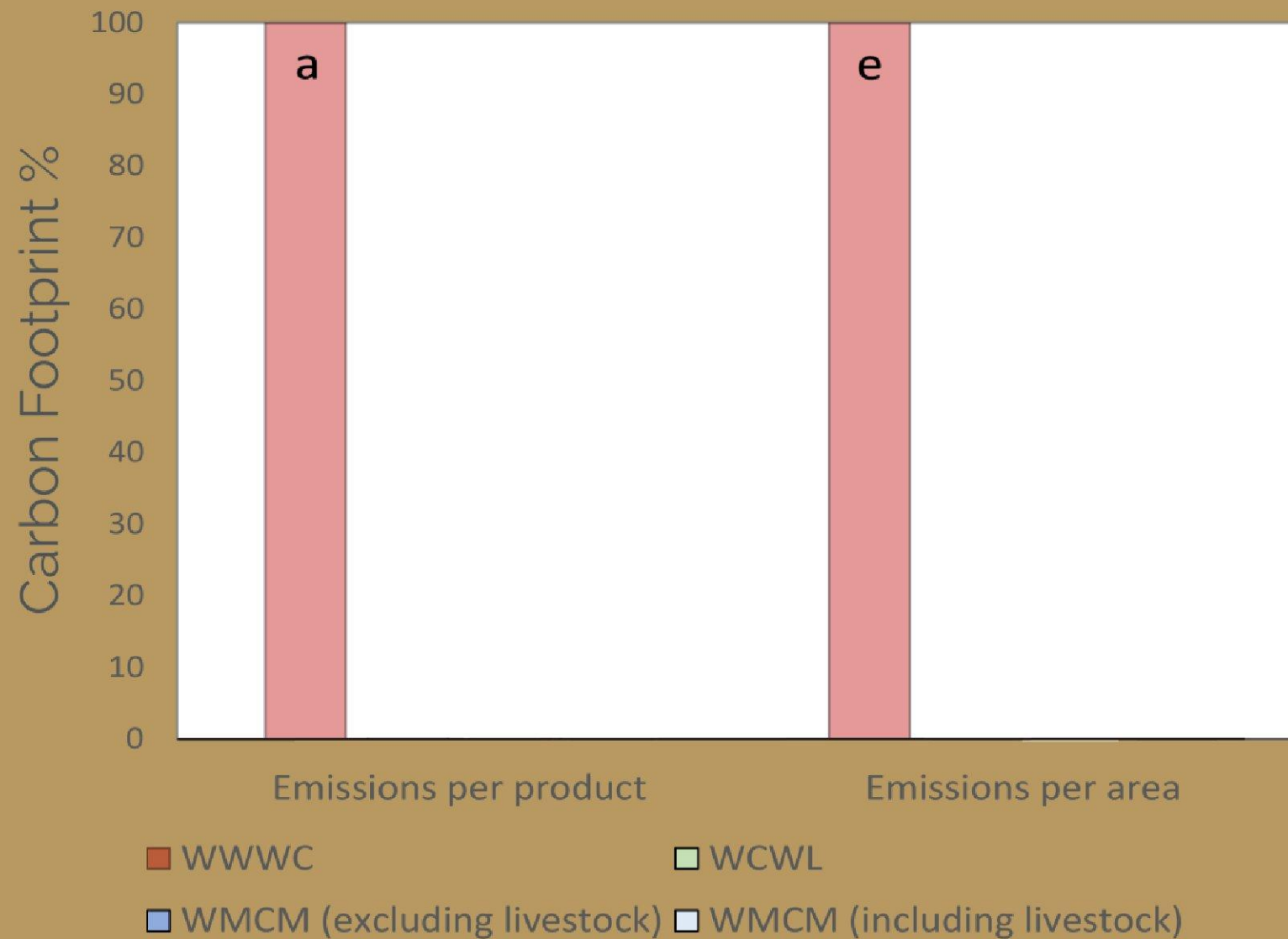
Carbon Footprint of different agricultural commodities



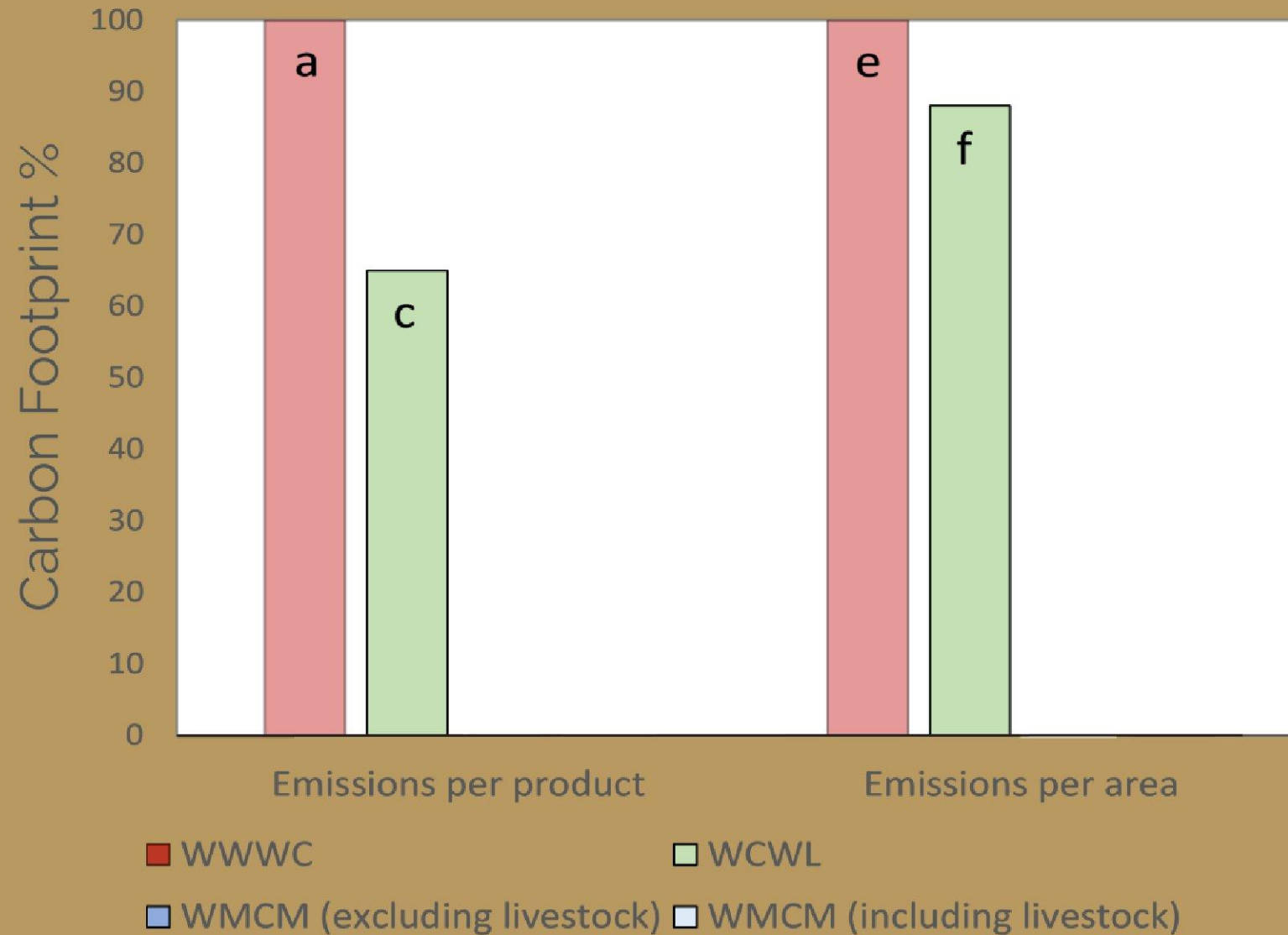
L. Matthews, 2022



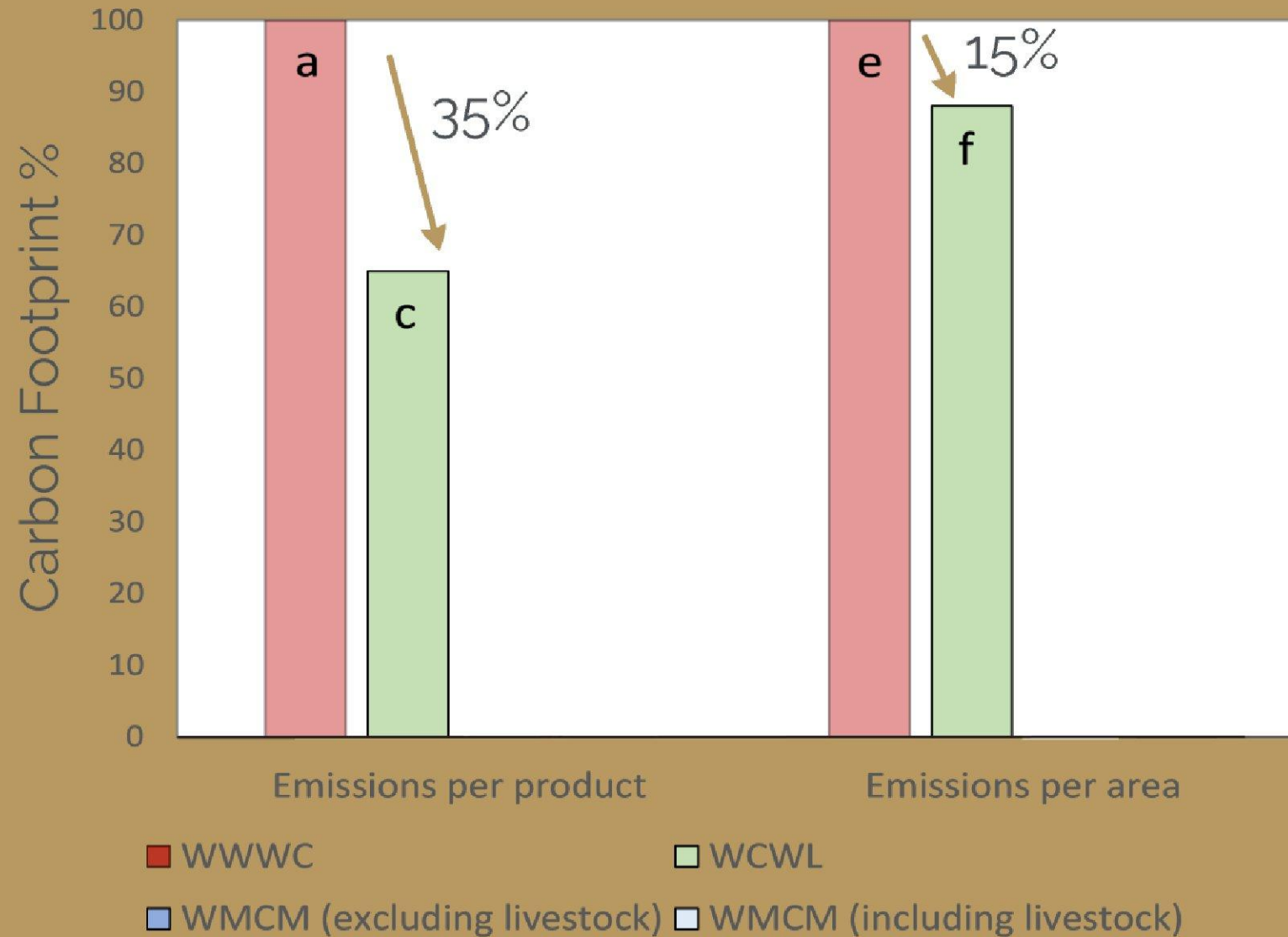
Carbon Footprint of different crop rotations



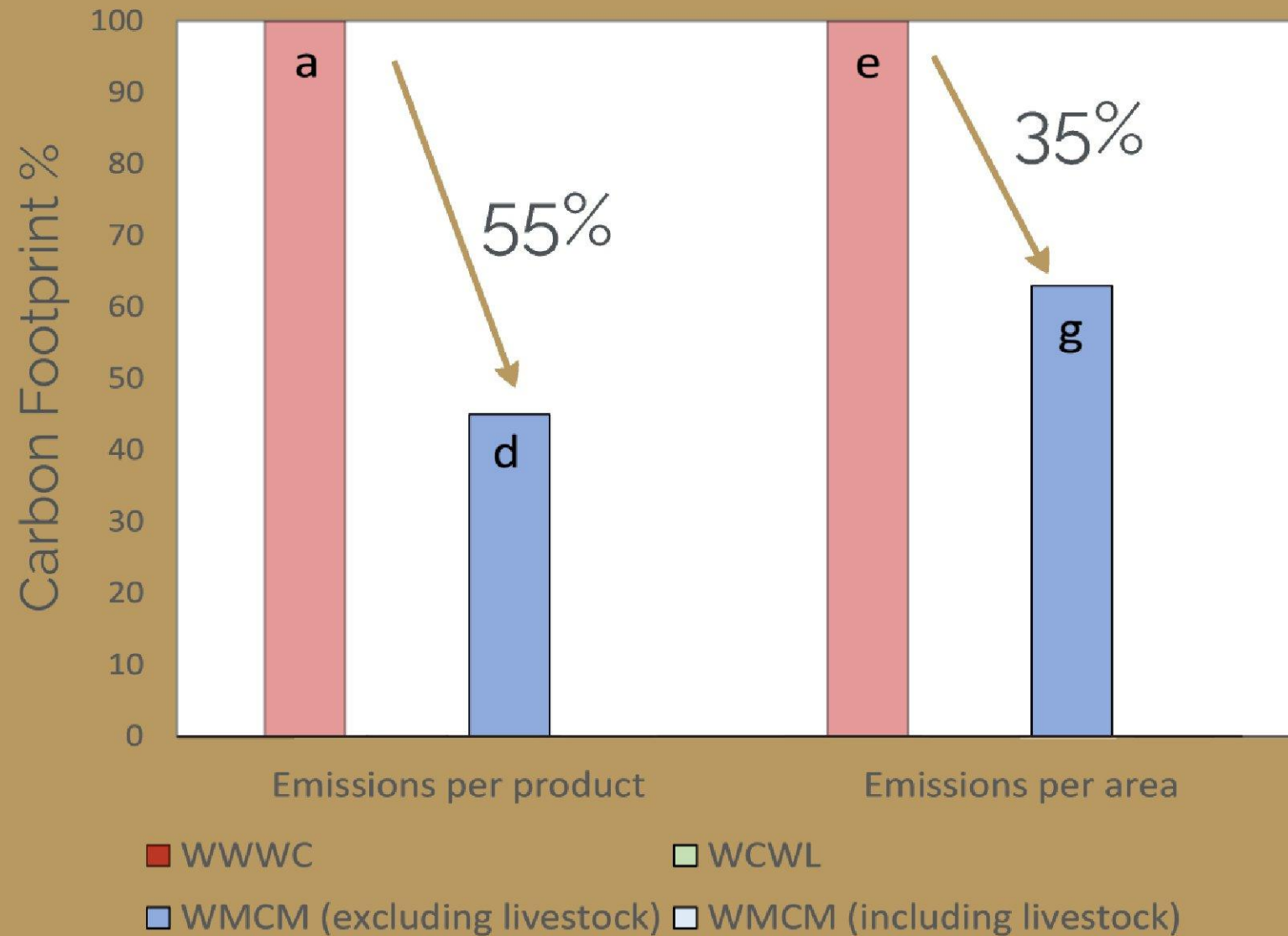
Carbon Footprint of different crop rotations



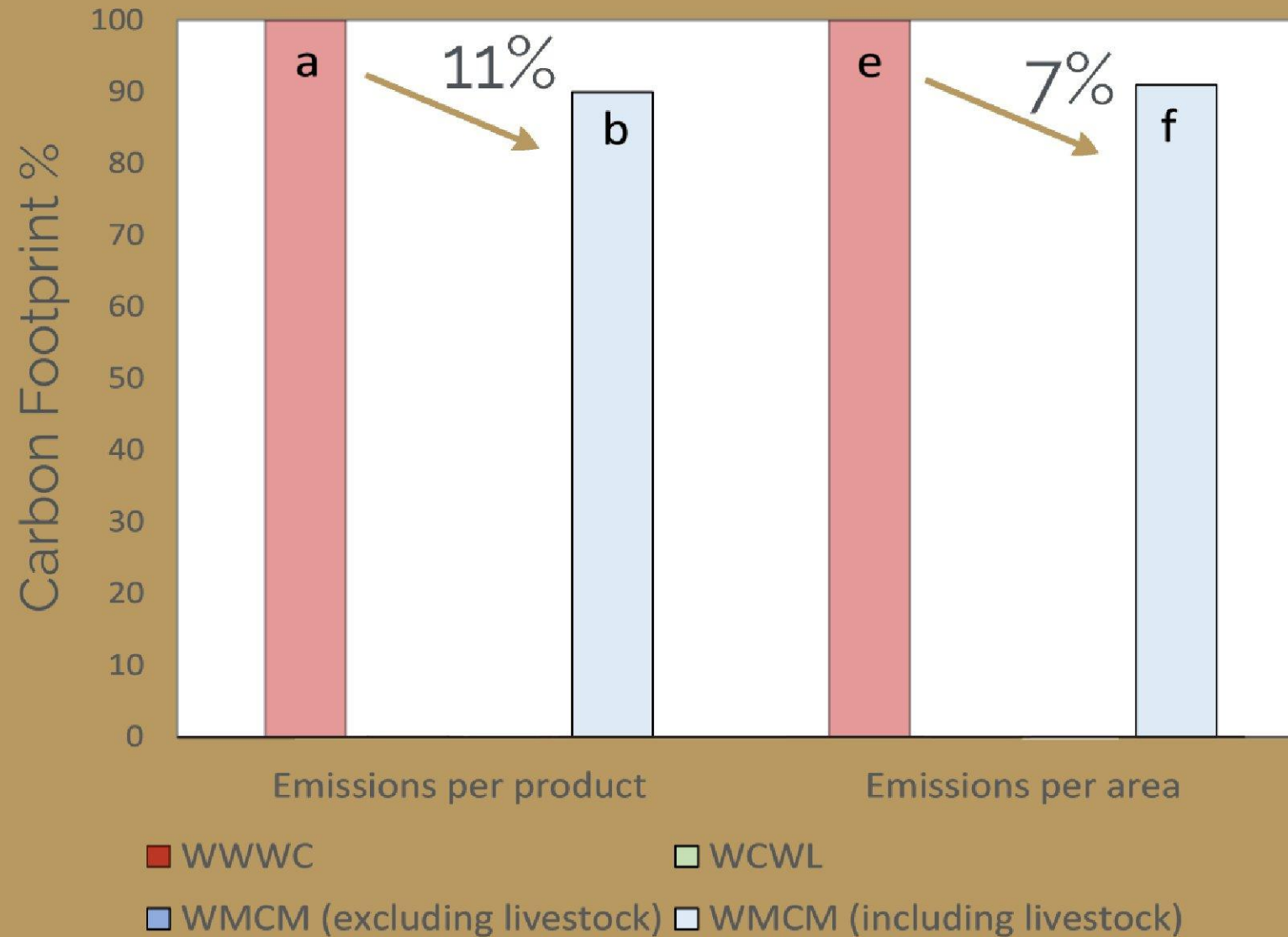
Carbon Footprint of different crop rotations



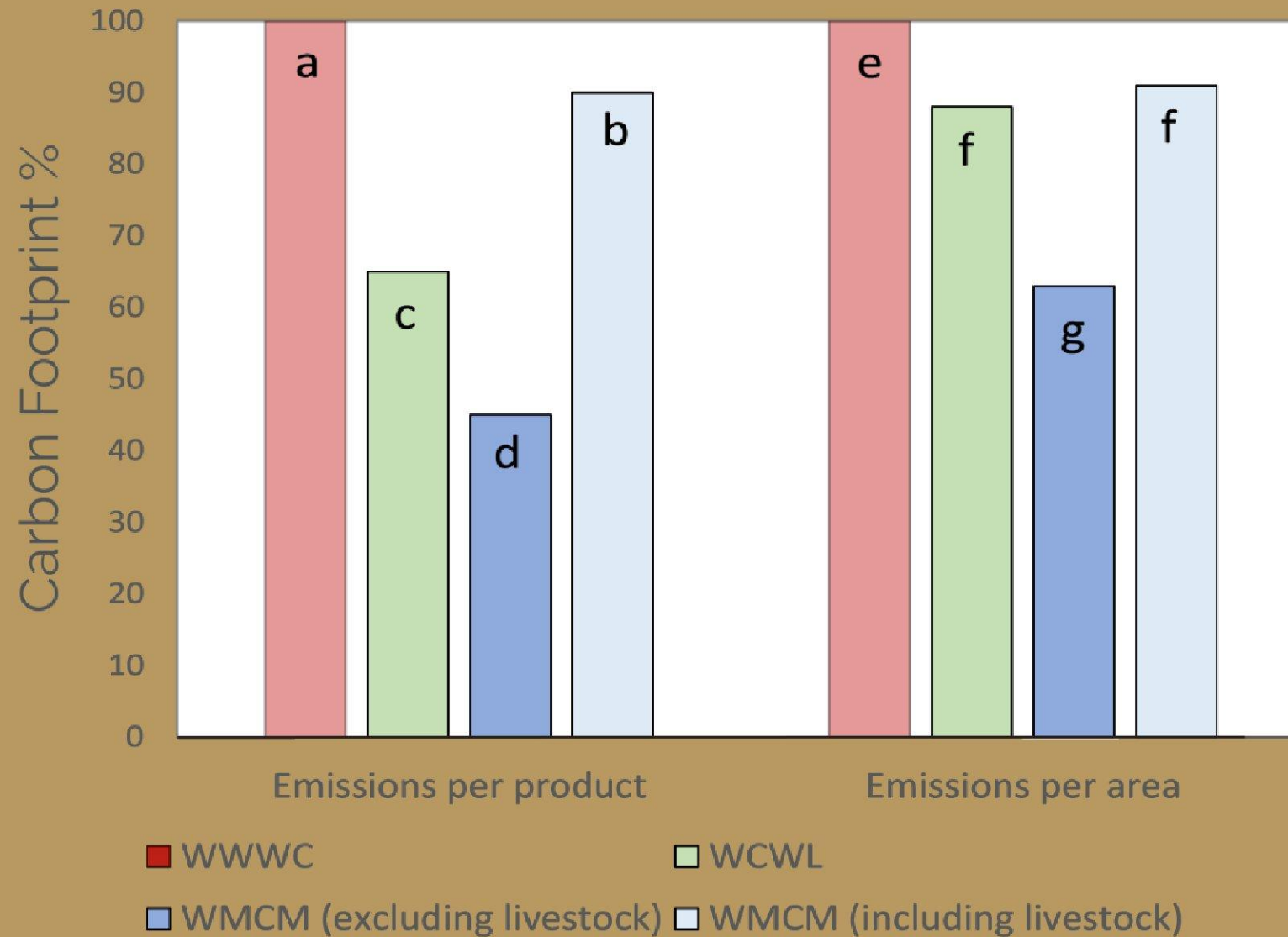
Carbon Footprint of different crop rotations



Carbon Footprint of different crop rotations

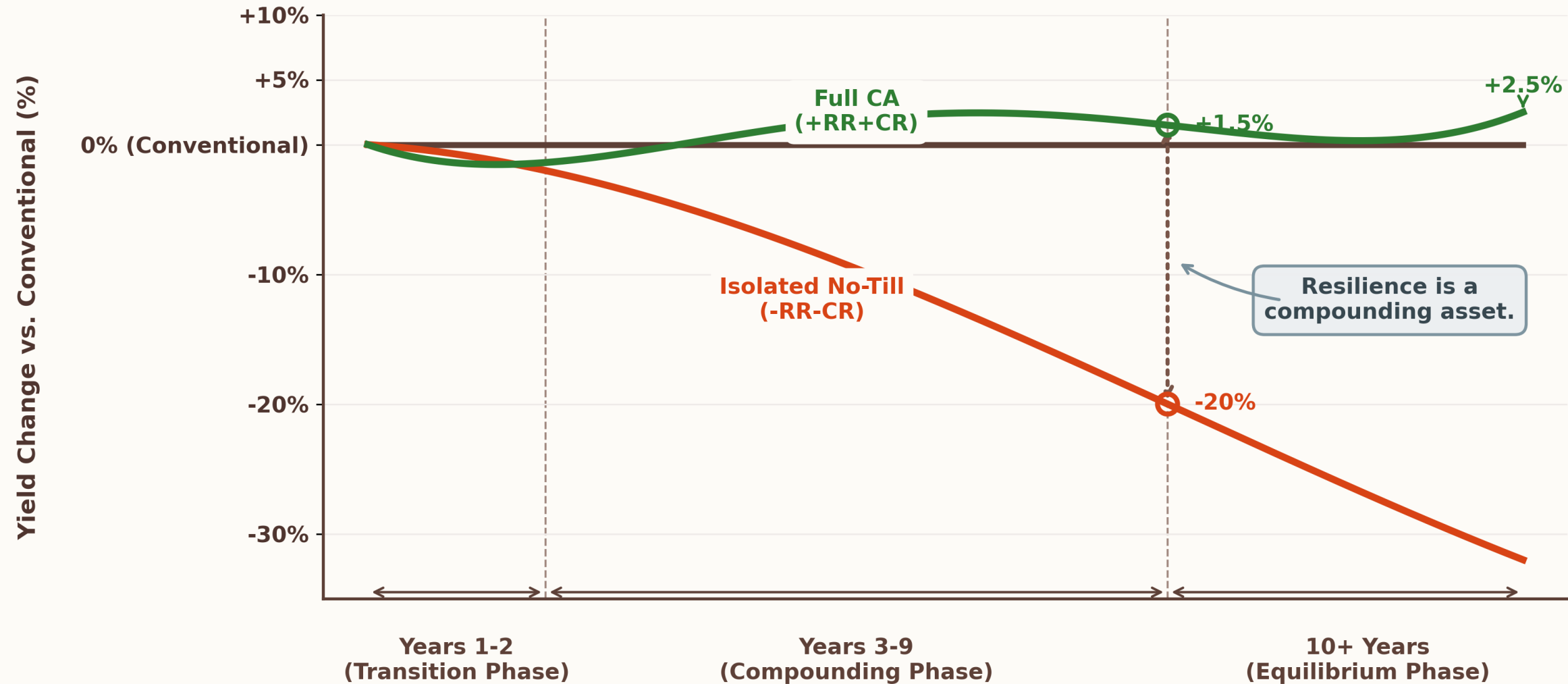


Carbon Footprint of different crop rotations



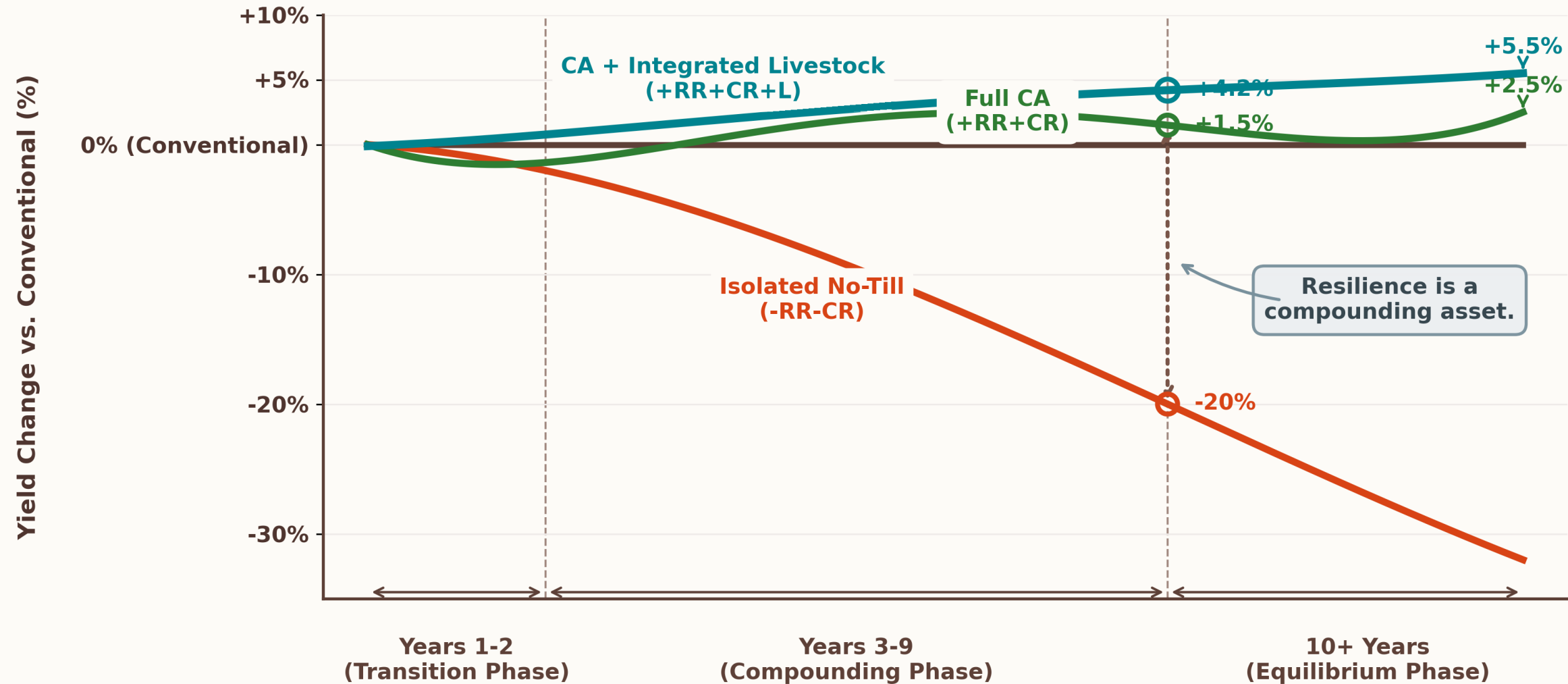
The Resilience Dividend in Conservation Agriculture

After a decade of consistent biological management, the system reaches a stable yield equilibrium.
Full Conservation Agriculture neutralises the initial yield penalty entirely, whereas isolated no-till leads to structural decline.



The Resilience Dividend in Conservation Agriculture

Integrating livestock with full Conservation Agriculture (+RR+CR+L) accelerates biological activity and nutrient cycling, eliminating the transition-phase yield penalty and compounding long-term yield benefits much faster.



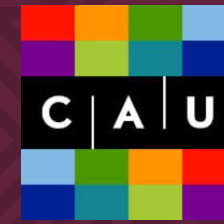
Conclusion

Livestock are a management tool that improve crop yields, resilience, and ultimately environmental outcomes

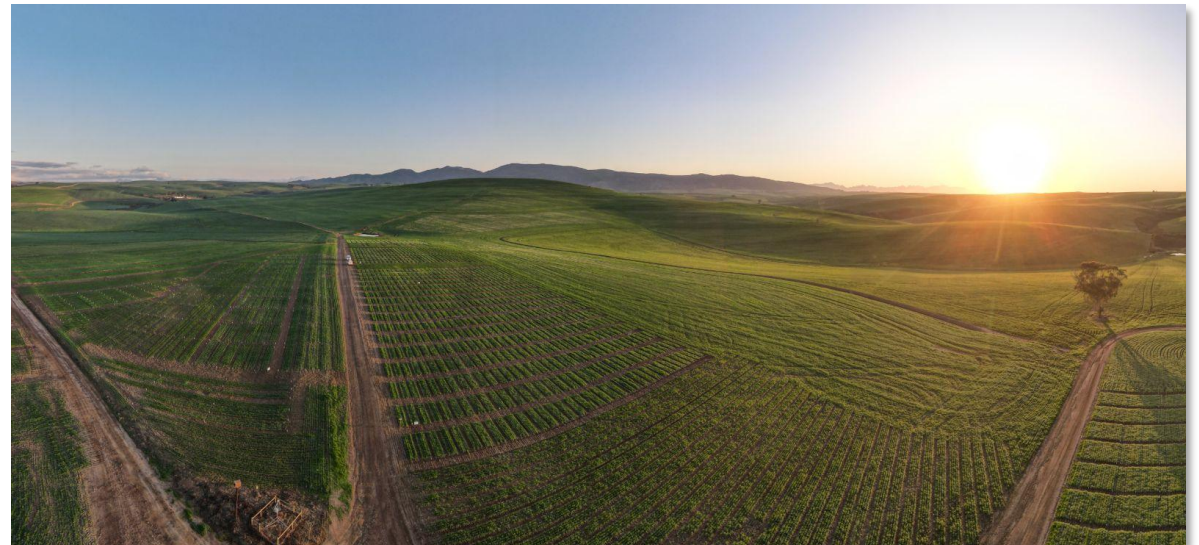
- Integrated crop-livestock systems improve resilience
- Livestock enable profitable legume phases
- Biological nitrogen can reduce fertiliser dependence
- Well-integrated livestock systems are not necessarily a carbon liability
- Productivity and environmental stewardship can be achieved together



Acknowledgements



- Protein Research Foundation
- Western Cape Department of Agriculture
- Christian Albrechts University, Kiel - Germany
- Prof Johann Strauss
- Dr Henk Smit
- Dr Chloe MacLaren
- Lisa Matthews
- Louise Bestbier
- Amandrie Louw





Stellenbosch

UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

forward together
sonke siya phambili
saam vorentoe

Thank you - Dankie - Enkosi