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Sustainable Irrigation Technologies : a water-energy-food (WEF) nexus perspective towards achieving more crop per drop per joule per hectare

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Innovative water solutions for sustainable development

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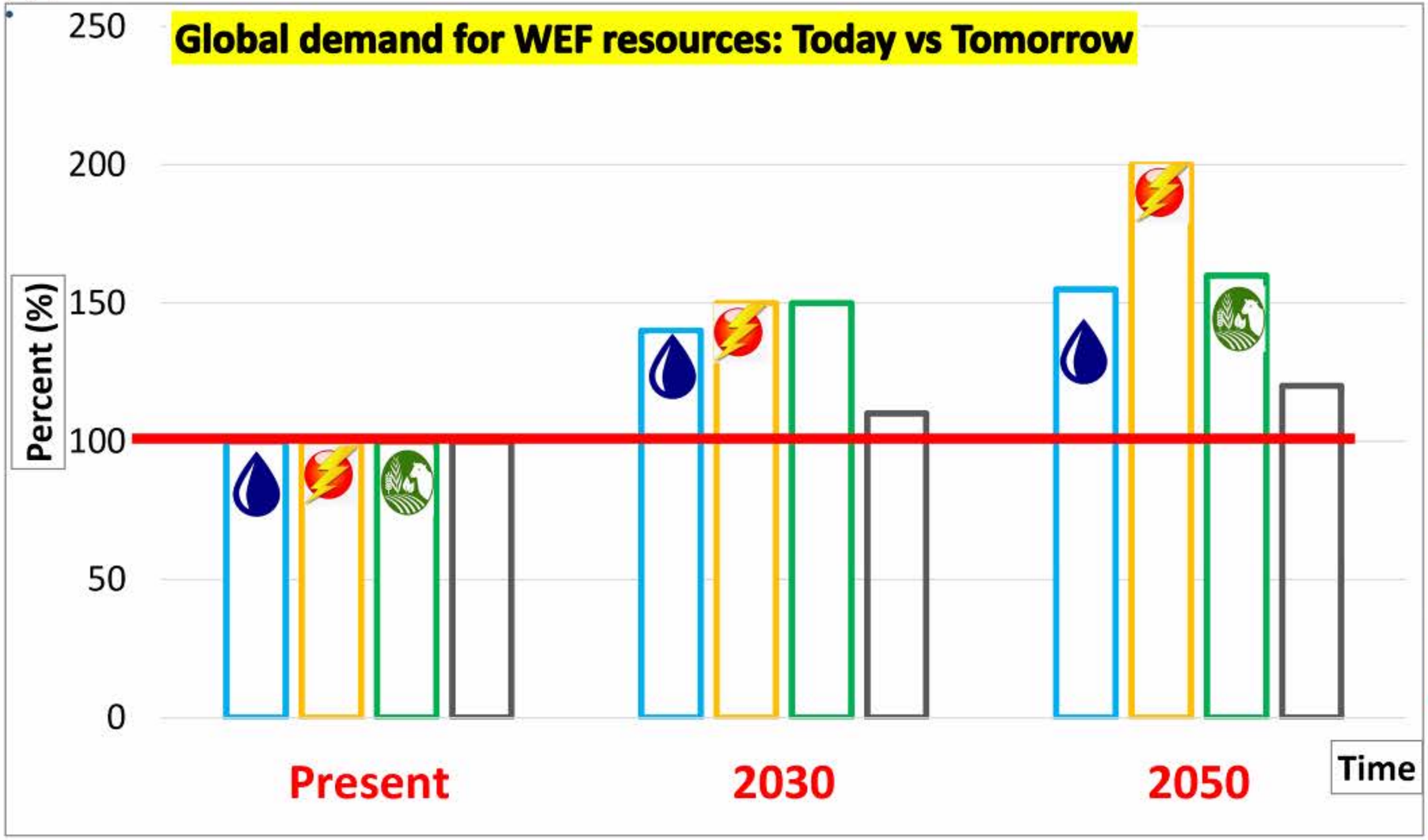
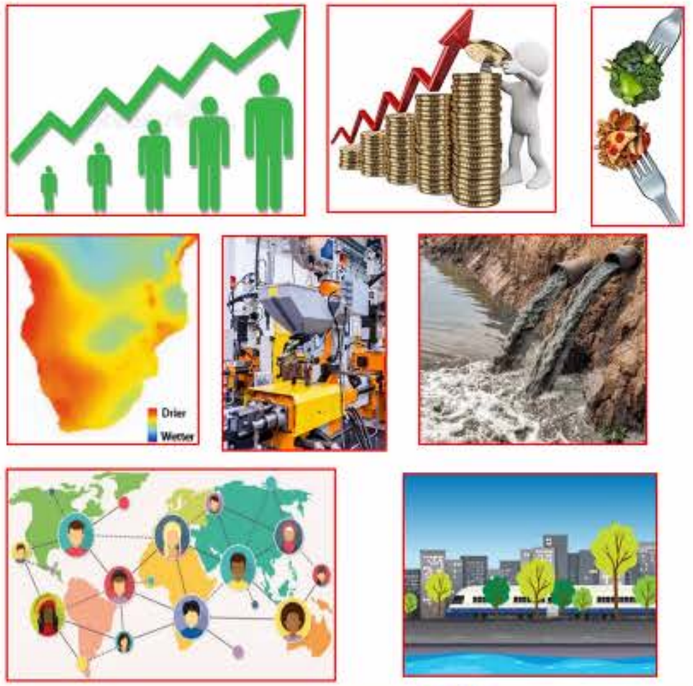
Presentation outline

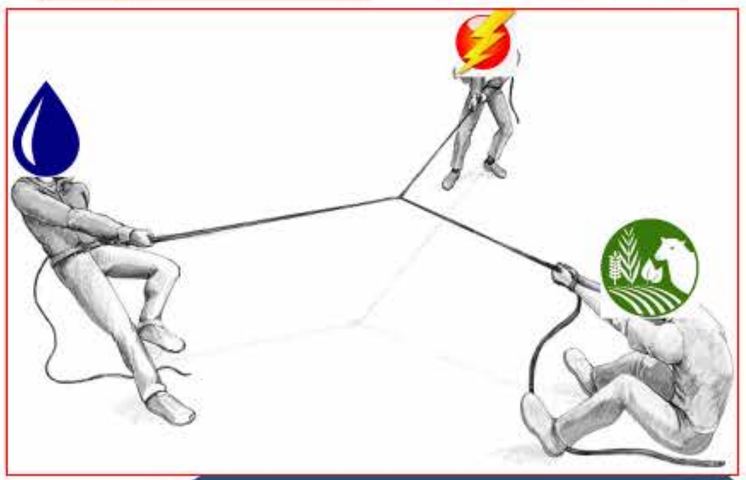
1. Background and context
2. Objectives
3. Methods
4. Results
    - Silo-based performances: Water, Energy, Food
    - Integrated WEF nexus-based performance
    - Summary
5. Key considerations
6. Conclusion
7. Acknowledgements

Background



Drivers of pressure





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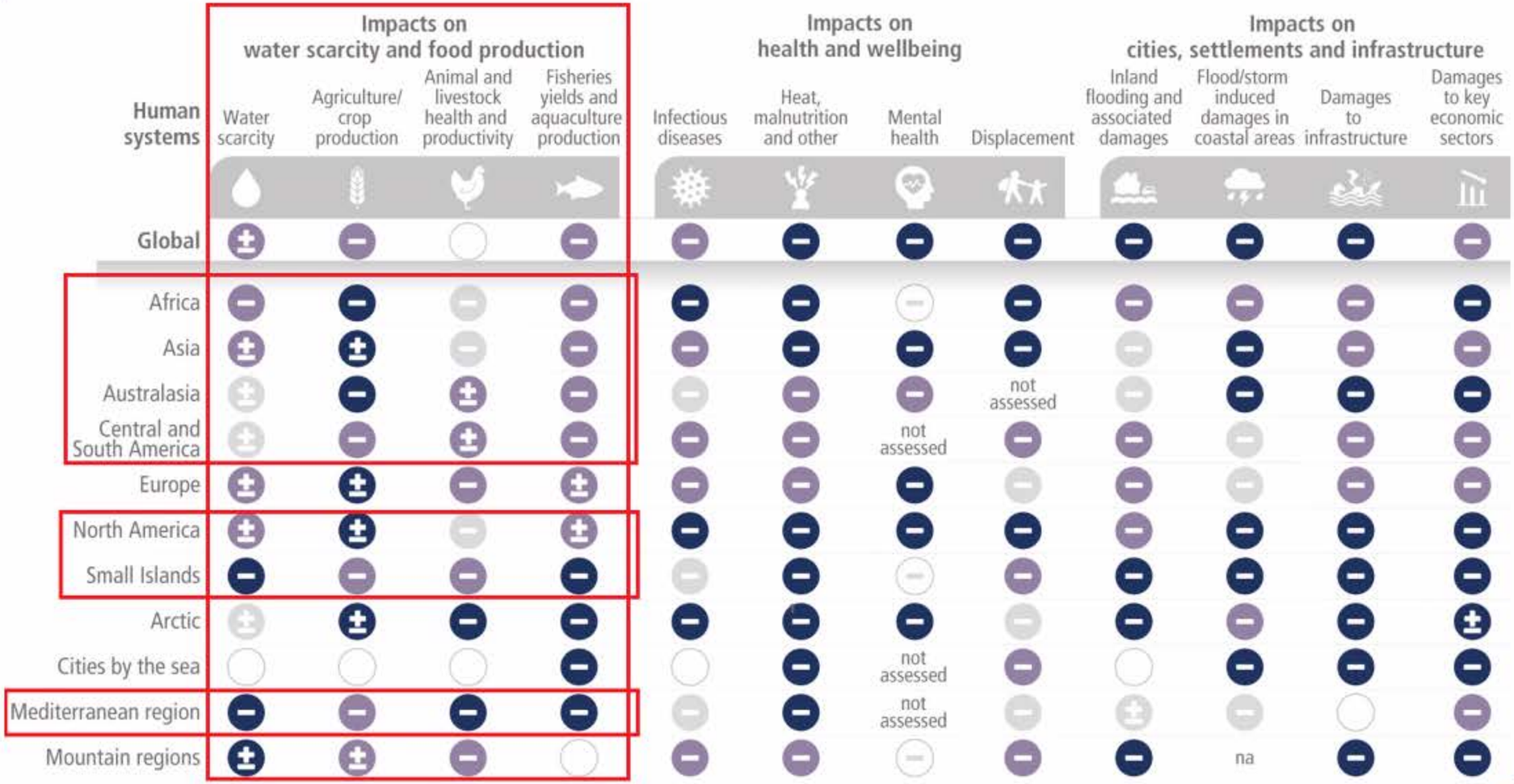
Observed impacts of CC on human systems in the global South



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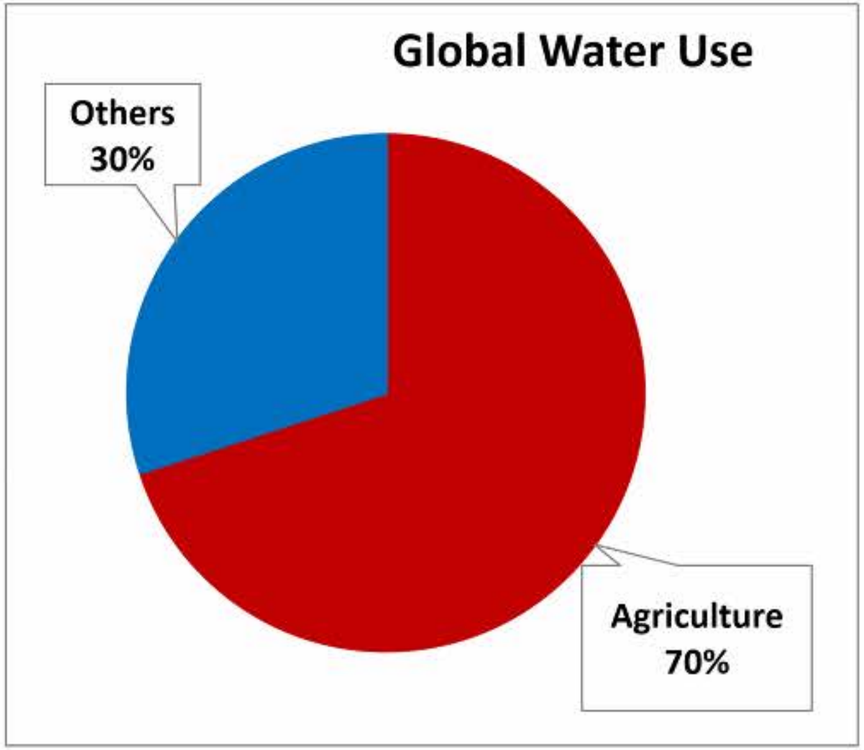
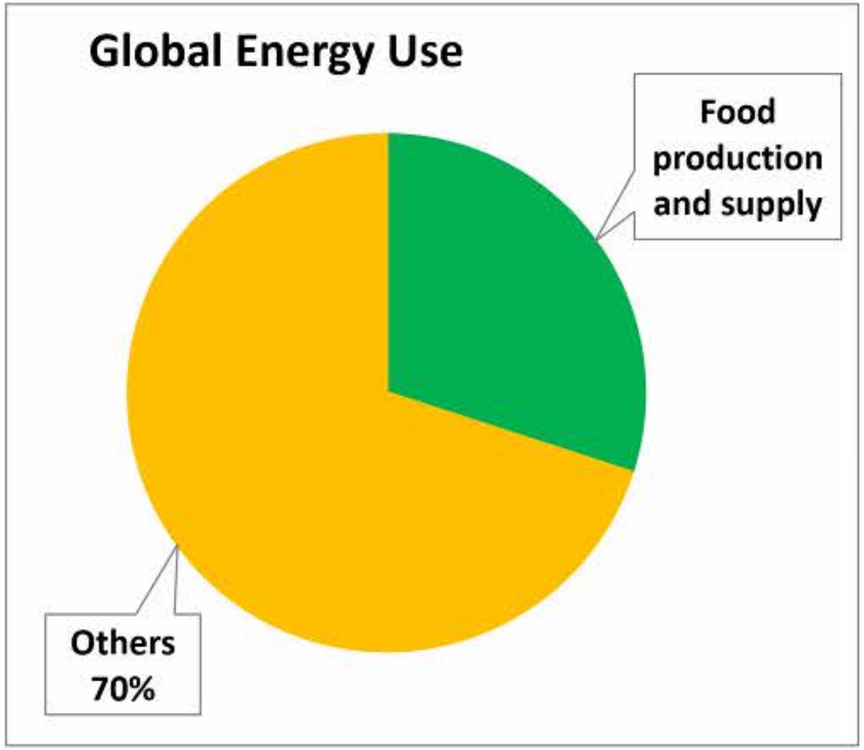
Water and energy in agriculture



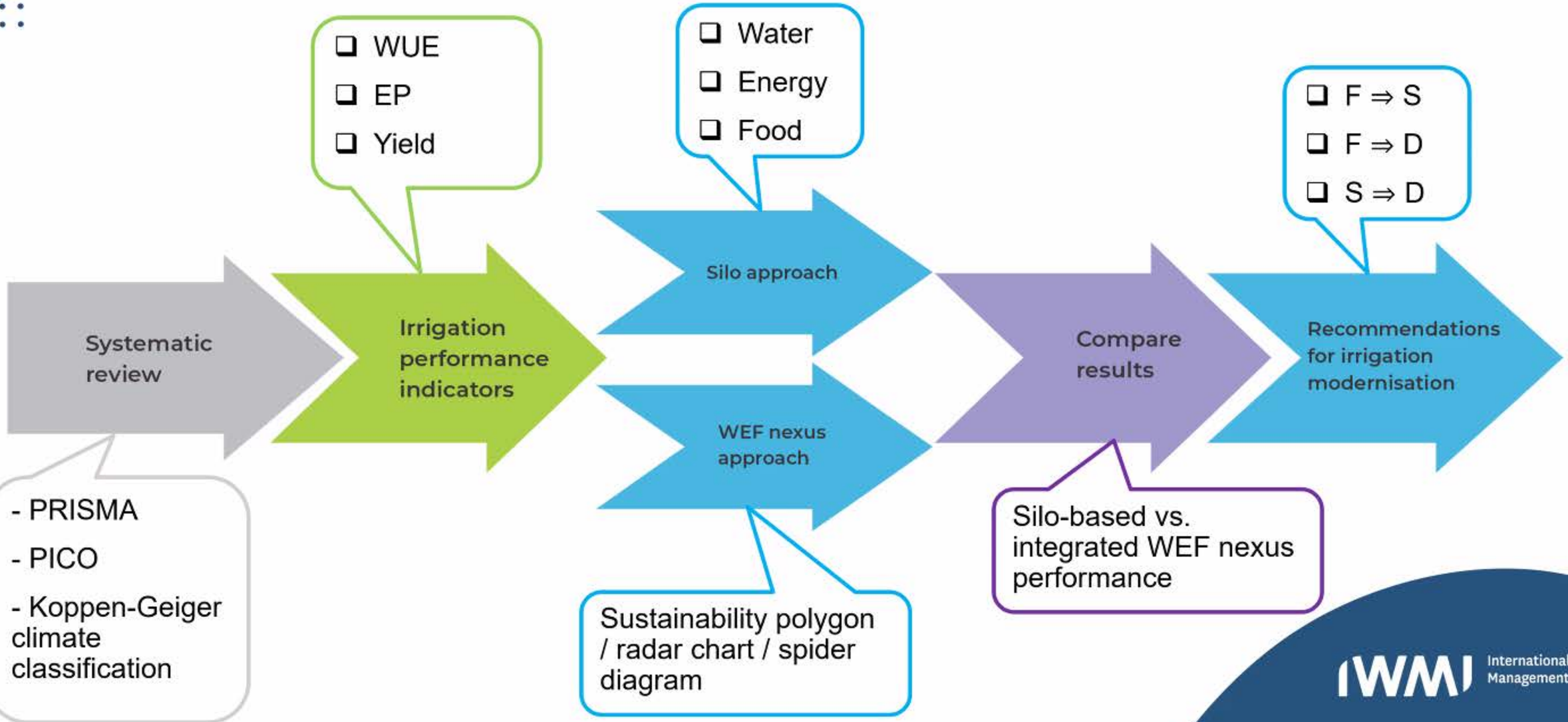


- AWM needs to align with COP26-proposed long-term strategies & commitments towards net-zero emissions by 2050

Pertinent Questions:

- How does silo-based (traditional/conventional) performance of irrigation systems differ from an integrated nexus performance?
- Can a WEF nexus approach be applied to holistically appraise the performance of irrigation systems?
- What are the WEF nexus implications of irrigation modernization? What are the nexus-friendly irrigation modernization pathways for the different climate zones?

Methods



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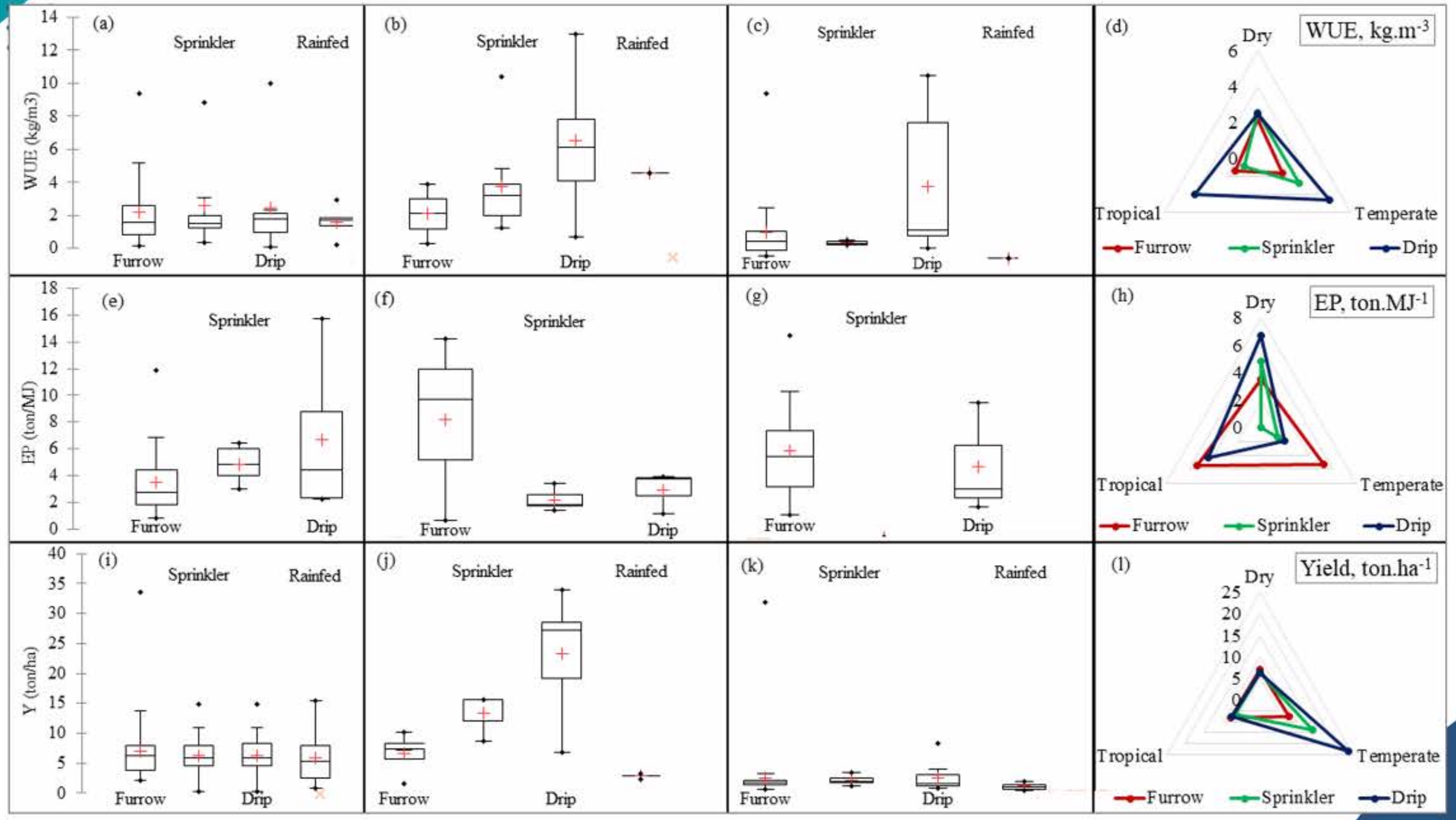
Results 1: Silo-based performances: Water, Energy, Food



Key:

WUE = water use efficiency;
EP = Energy productivity;
Y = Yield

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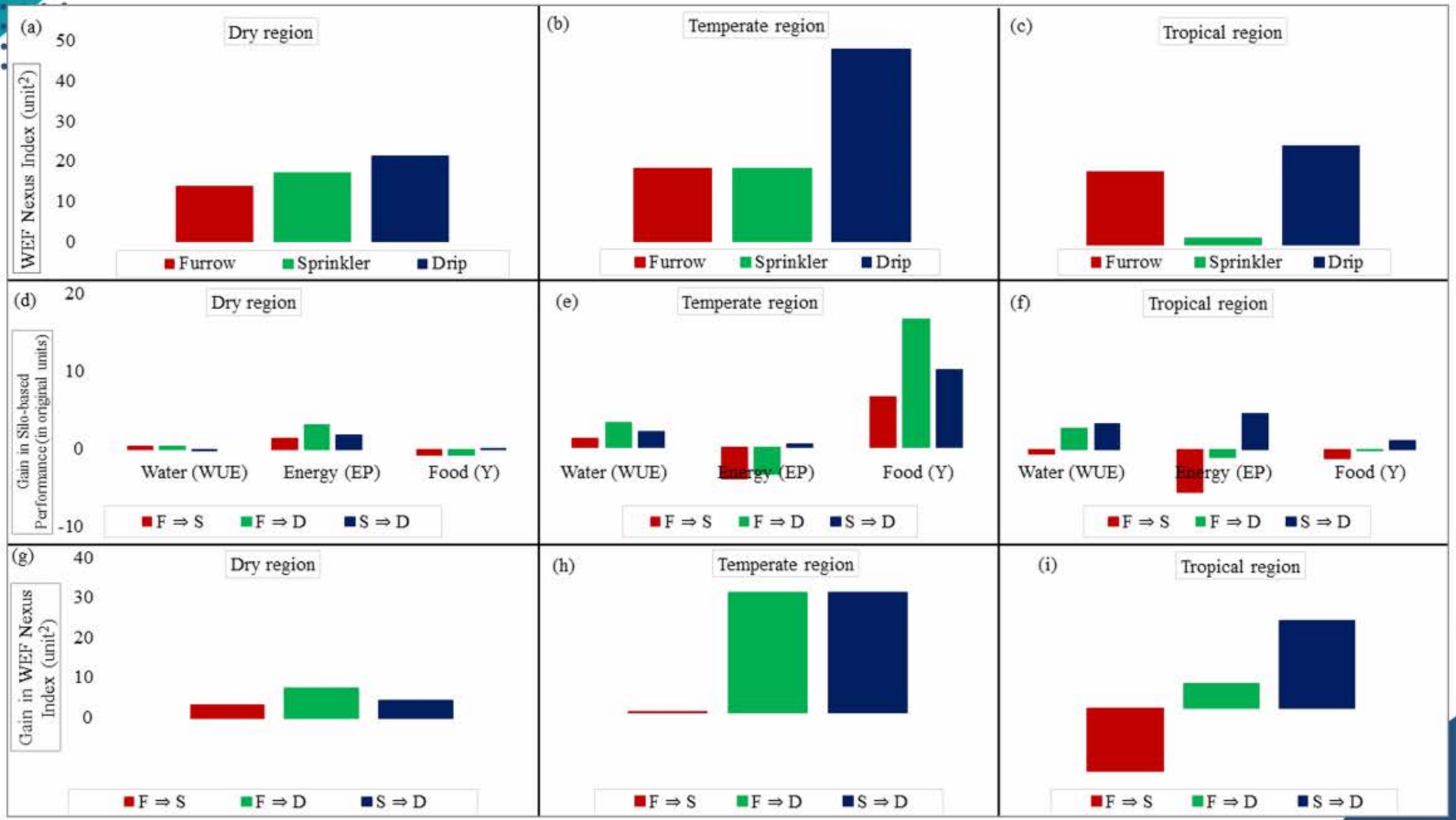
Results 2: Integrated WEF nexus-based performance



Integrated WEF nexus performance of irrigation systems in (a) dry, (b) temperate, and (c) tropical climates; impacts of irrigation modernisation on the water, energy, and food performance from a silo approach in (d) dry, (e) temperate, and (f) tropical climates; and impacts of irrigation modernisation on the WEF nexus in (g) dry, (h) temperate, and (i) tropical climates.

Results 3: Summary

Climate	Silo-based Performance of Irrigation Systems			WEF Nexus Index
	Water (WUE)	Energy (EP)	Food (Y)	
Dry	*S > D > F*	*D > S > F*	*F > D > S*	*D > S > F*
Temperate	*D > S > F*	*F > D > S*	*D > S > F*	*D > S* > F**
Tropical/Continental	*D > F > S*	*F > D > S*	*F > D > S*	*D > F > S*

Key considerations

- Silo-based appraising of irrigated agriculture produce mixed result, rendering an unsustainable picture on performance of irrigation systems.
- Sustainable irrigation development under CC will require, among other things, integrative approaches and irrigation technologies and strategies that help to increase yields while optimising water, land, and energy use efficiencies and environmental wellbeing.
- A daunting and complex task, which calls for:
  - managing rather than meeting demand,
  - transformative and systems approaches,
  - landscape-level management, and
  - transitioning food systems towards being sustainable and resilient.

Key considerations

- Requires an understanding of trade-offs and synergies among the interlinked water, energy, food and land systems: the integrative WEF nexus approach.
- Need to consider relative importance and priorities in local WEF nexus case studies.
- Key factors (e.g., cost, crop, etc) need to be considered when planning irrigation modernization.
- We need to reach beyond the water system – it is not just about managing water alone!
  - Nutrition and health
  - Energy
  - Environment

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Coming together as the water sector at COP26

- Water pavilion
- 32 organisations came together – one voice and one venue
- Reaching beyond sectoral boundaries
- TFocus on water and food

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Conclusion

- The WEF nexus approach has potential to holistically appraises performance of irrigated agriculture.
- Drip irrigation was favored by WEF nexus approach, however adoption needs careful and informed consideration.
- Irrigation modernization to be complemented with sound basin-wide water management to realize WEF nexus benefits.
- Need to investigate the WEF nexus implications of other promising nexus-friendly sustainable agriculture interventions: renewable energy, agrivoltaics, CEA, PA, IoT, S&WC, DI, improved irrigation scheduling, energy auditing, and CSA

Acknowledgements

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  - WRC Project /C2019/2020-00007 on “From theory to practice: developing a case study and guidelines for water–energy–food (WEF) nexus implementation in southern Africa”;
  - WRCK5/2967//4 on “Water-Energy-Food Nexus as a sustainable approach for advancing food and nutrition security and achieving SDGs 2, 6 and 7 with specific attention to efficient energy use food production”.
- Wellcome Trust:
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