Sustainable Intensification: Decoupling Resource use from Socio-economic Benefits in Southern Africa

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Australian Government
Australian Centre for International Agricultural Research

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Introduction

Transforming small-scale irrigation schemes from dysfunctional to functional systems:

- From top down, capital intensive engineering and technology solutions
- Extensive use of land and water for very low yields
- Resulted in the build – fail – rebuild cycle
- To engaging irrigation communities in identifying solutions that increase productivity and profitability
- Decoupling production from resource use?


Tshongokwe, Zimbabwe 2018 © J Pittock

Transforming irrigation in southern Africa

Phase	1: 2013-17	2: 2017-23
Funding $US	2.4 million	4.0 million
Irrigation schemes	6	42
Farmers	1,641	15,500+

Small holders: average land area 0.5 ha

Lead funder –

Australian Government

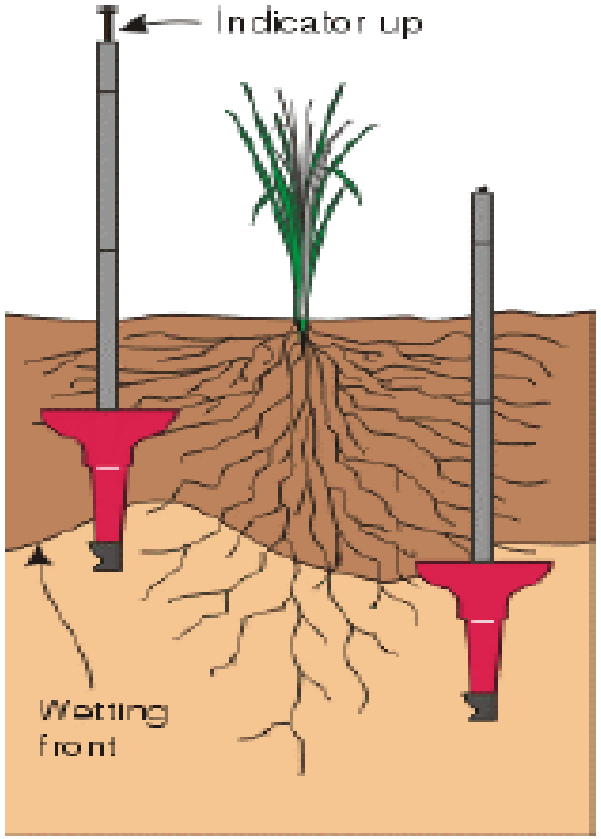
Australian Centre for International Agricultural Research

Intervention1: Simple to use soil monitoring tools – increase learning & crop yields

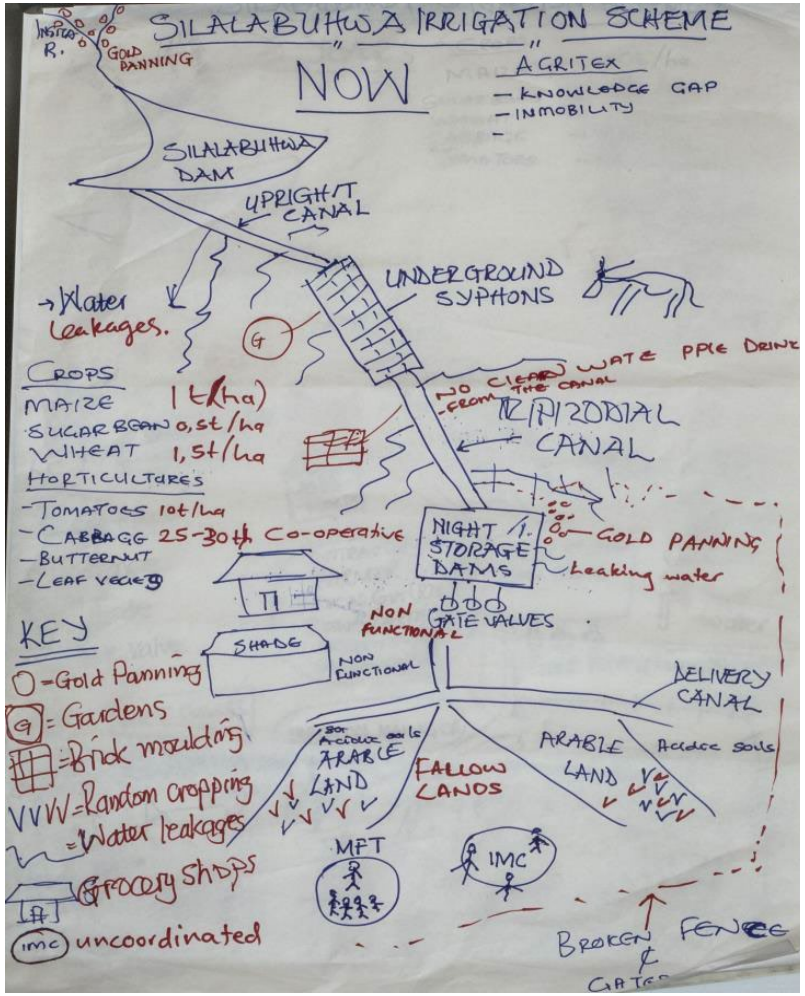
Dr Richard Stirzaker, CSIRO - https://via.farm/

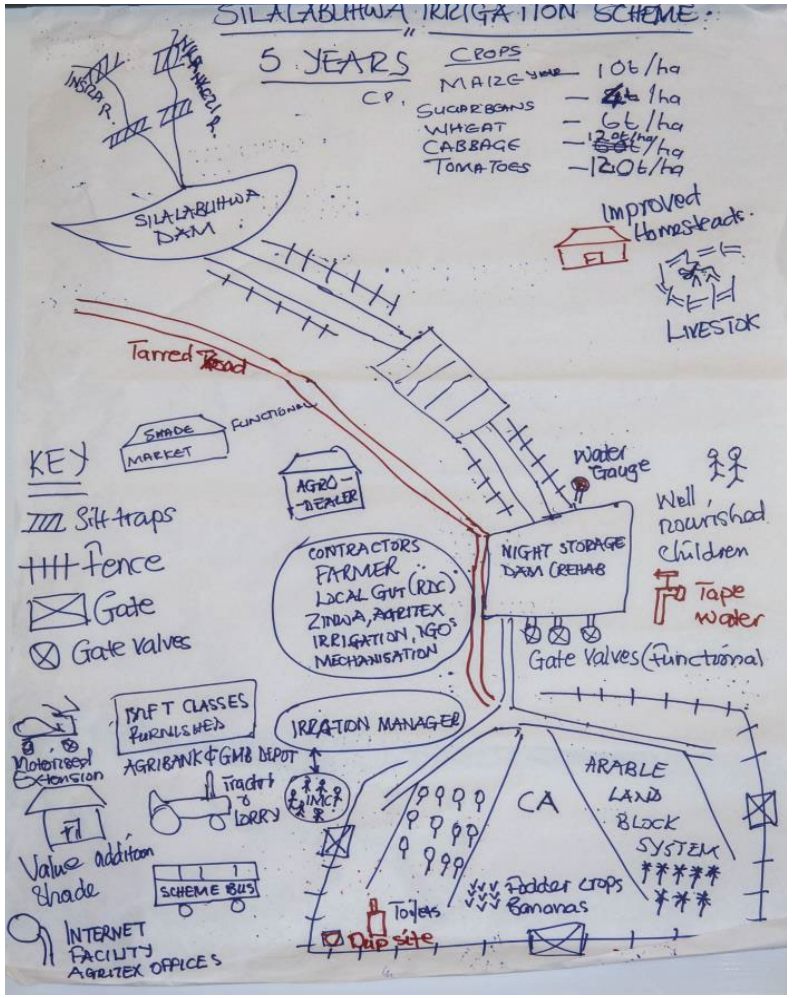
The Chameleon

The FullStop



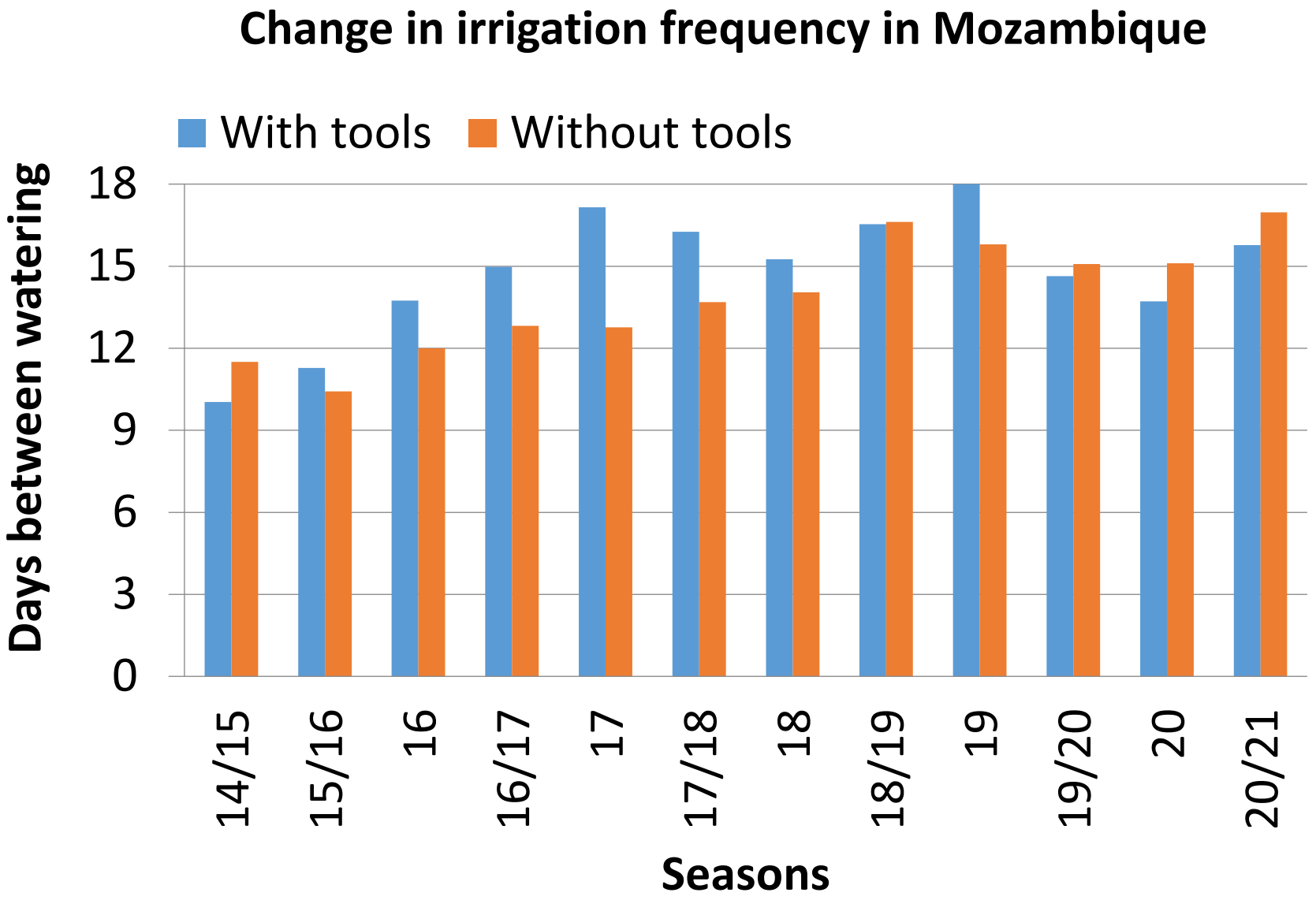
Intervention 2: Agricultural innovation platforms (AIPs) with communities – increase farming profitability





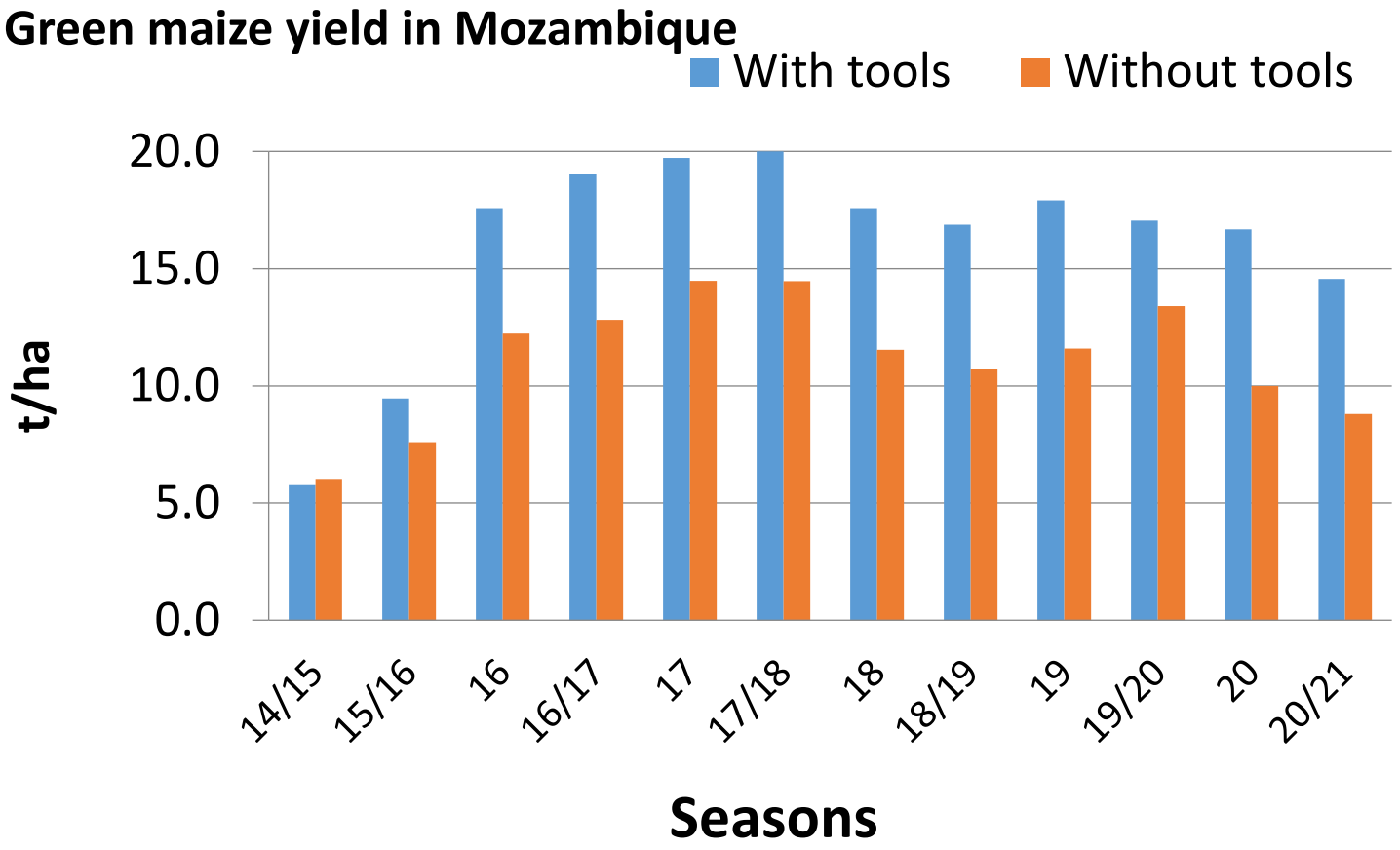
Examples of the current situation (*left*) and desired situation (*right*) produced from the visioning exercise in Silalatshani, Zimbabwe (van Rooyen et al., 2017)

Change in irrigation frequency (2014 – 2020)



1. **Tanzania** (change from 2.7 to 5 days interval)
2. **Zimbabwe** (change from 7 to 14 days interval)
3. Evidence of farmer-to-farmer learning

Changes in yields of green maize, 2014 – 2020



1. **Mozambique** (changed by > 200%, green maize)
2. **Tanzania** (changed by >50%, green maize)
3. **Zimbabwe** (change by > 300%, grain yield)

- **Changes due to a combination of tools and changes from AIPs, e.g. new business plans, better seeds, gross margin workshops**
- **Similar trends for gross margins increases in the three countries**

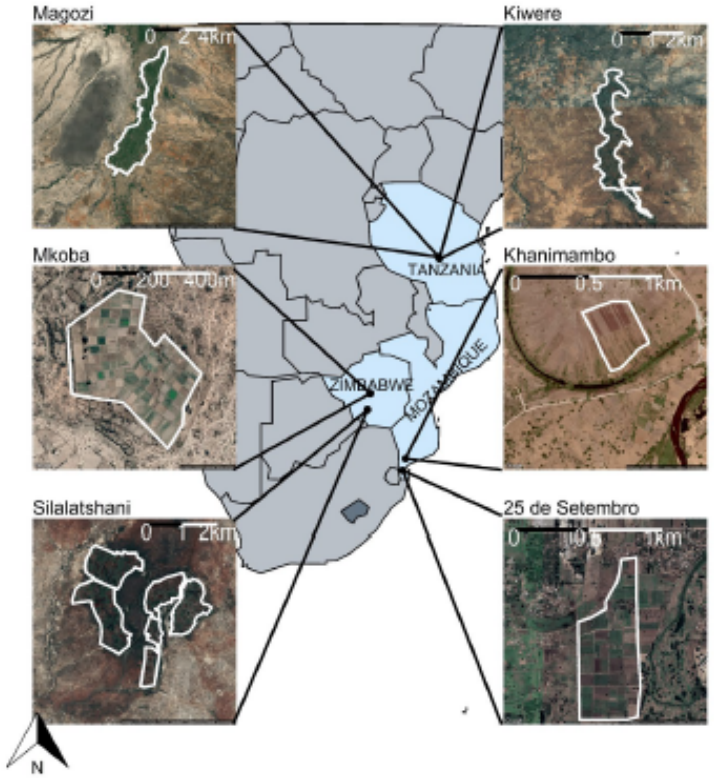
Intensification benefits from interventions (2014 – 2020; MZ, TZ, and ZM)

1. Reduction in the number of siphons used
2. Reduction in irrigation duration
3. Reduction in water and energy use
4. Increased crop yields
5. Saving labor
6. Engagement in off-farm activities
7. More efficient fertilizer use
8. Reduction in conflict, increase collaboration

More crop per drop? Independent GIS check:

Sites

Smallholder irrigation schemes, southern Africa



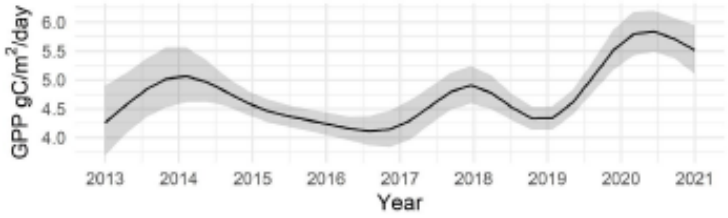
Methods

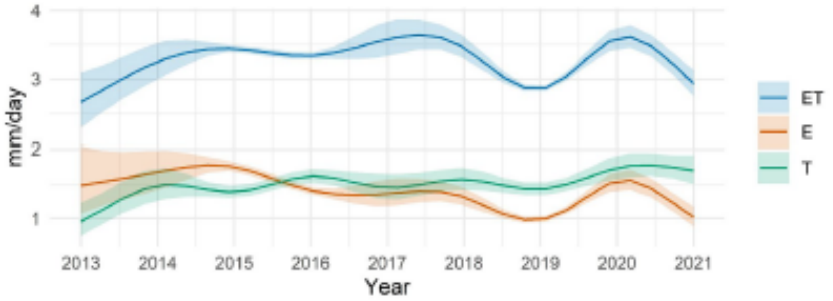
Trends in evapotranspiration (ET) and gross primary productivity (GPP)

Software and statistics:
Python implementation of the surface energy balance algorithm (PySEBAL) and generalised additive models (GAMS).

Results

Decoupling of GPP from ET at some schemes in space and time.





Conclusions

More food has been grown with less water, but results are context dependent.

M. Wellington, et al. 2023. Decoupling crop production from water consumption at some irrigation schemes in southern Africa. Agricultural Water Management 284:108358. DOI: https://doi.org/10.1016/j.agwat.2023.108358

Catalyzing more investment in intensification: circular systems

Example: Kiwere (TZ) farmers diversifying with dairy cows

- Farm income (from e.g. green maize) invested in dairy cows
- Use of crop residues for feed
- Milk produced sold to dairy in Iringa town or sol locally
- Emerging opportunities:
  - Milk collection and transportation services
  - Processing of crop residues into feed

Conclusions for sustainable intensification

a) Multiple social and technological intervention needed to improve sustainability and profitability
b) Empowering farming communities and businesses is essential
c) Significant decoupling of resource use from production is possible
d) Long term (10 years) research for development investment by ACIAR arch has enabled lasting change.

Feedlot in irrigation scheme, Tshongokwe, Zimbabwe 2018 © J Pittock

More information on TISA:

- Guide to *Transforming smallholder irrigation schemes in Africa*: https://www.aciar.gov.au/publication/Transforming-smallholder-irrigation-schemes-Africa
- Bjornlund, H.; Pittock, J. and van Rooyen, A. Eds. (2020): Transforming Small-Scale Irrigation in Southern Africa. Special Issue of the International Journal of Water Resources Development 36(S1)
- Project website: *http://fennerschool.anu.edu.au/research/projects/africa-irrigation-and-water-project-increasing-irrigation-water-productivity-3*