
# Transforming Maize-legume Value Chains –

## A Business Case for Climate-Smart Agriculture in Southern Africa

*By Christian Thierfelder, Geofrey Siulemba, Moses Mwale and colleagues from Malawi and Zimbabwe*

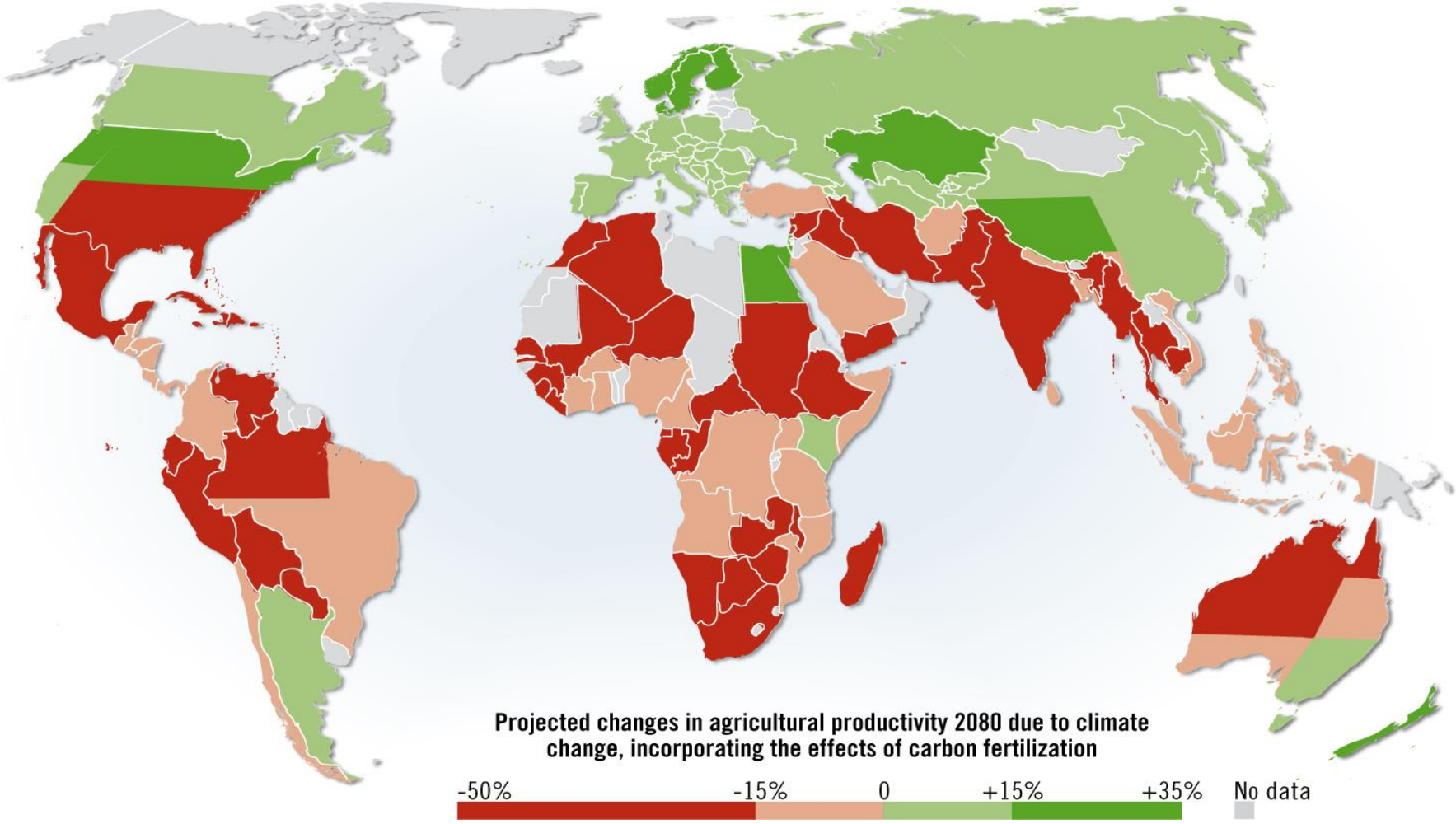
CIMMYT
International Maize and Wheat Improvement Center

CCARDESA

german cooperation
DEUTSCHE ZUSAMMENARBEIT

giz

# Projected change in Agriculture Productivity, 2080




Source: ***Hugo Ahlenius, UNEP/GRID-Arendal.***

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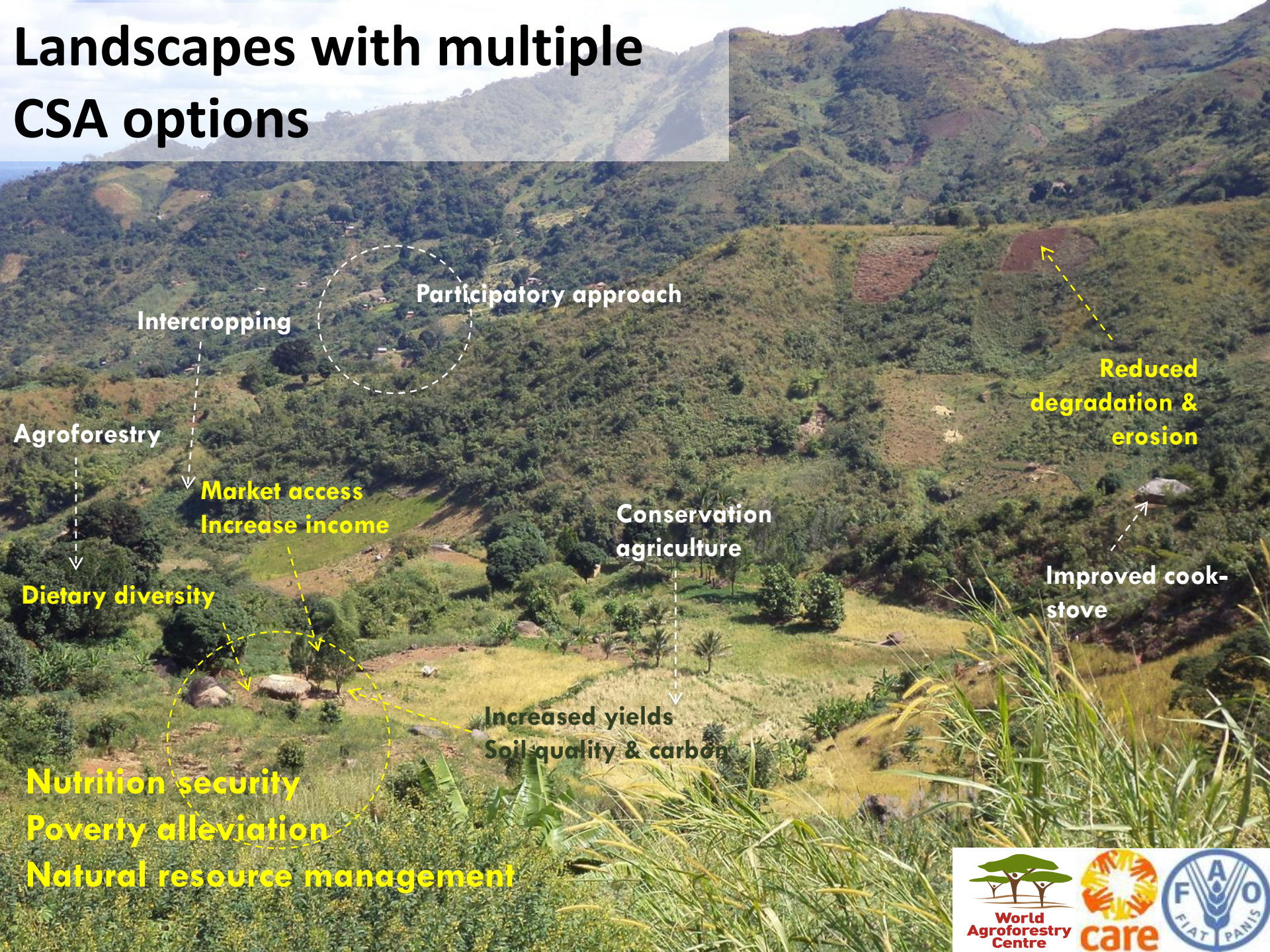
# Traditional African smallholder farming systems

- Based on **tillage** (manual/animal traction)
- **Residue** removal
- Monocropping of **maize**
- Limited **fertilizer** use
- Based on **traditional** varieties
- Affected by **variable climate**
- Inherently **poor soil fertility**

# The Challenges

# Landscapes with multiple CSA options




World Agroforestry Centre

care

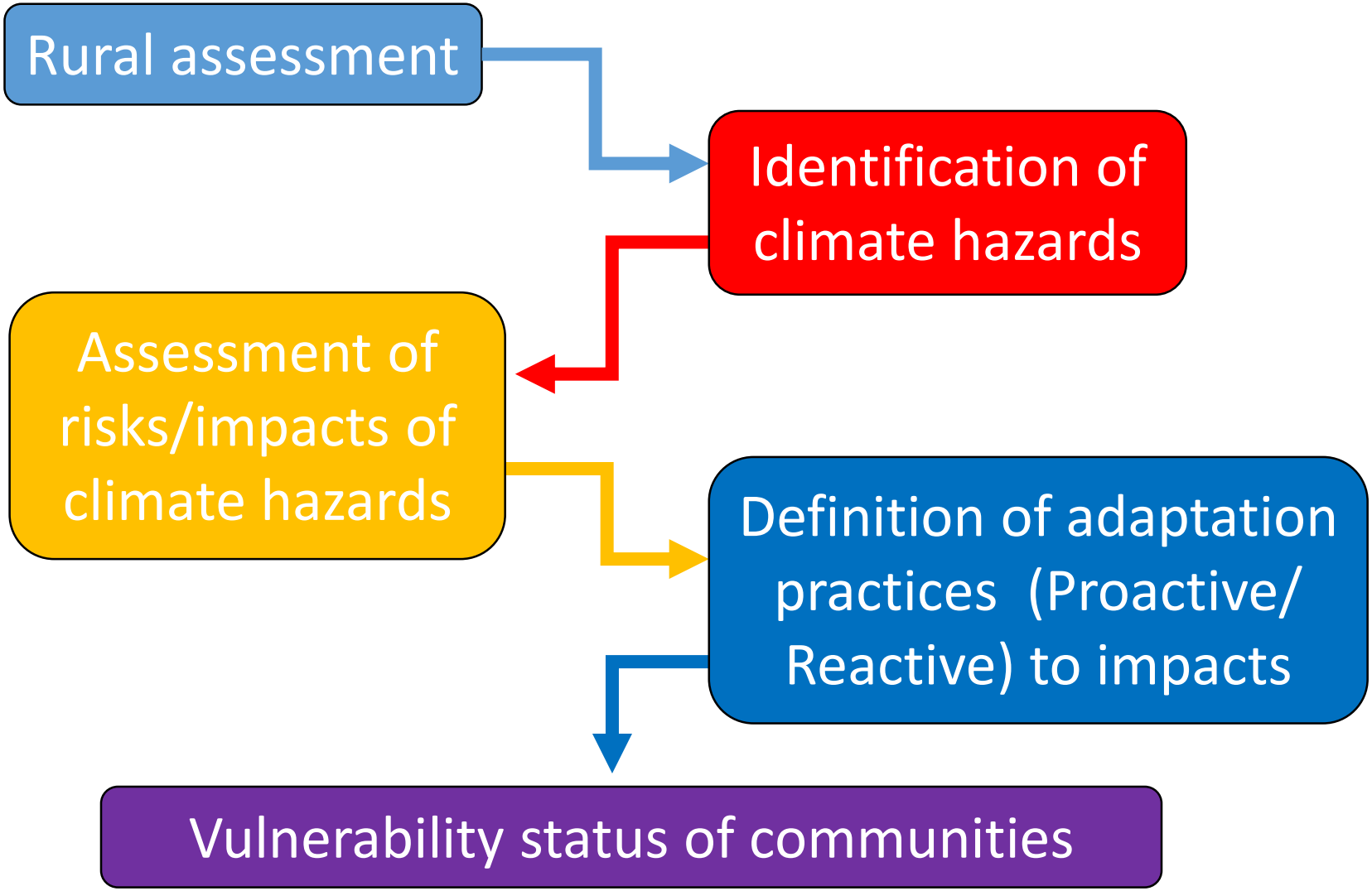
FAO FIAT PANIS

# Out scaling climate-smart technologies to smallholder farmers in Malawi, Zambia & Zimbabwe

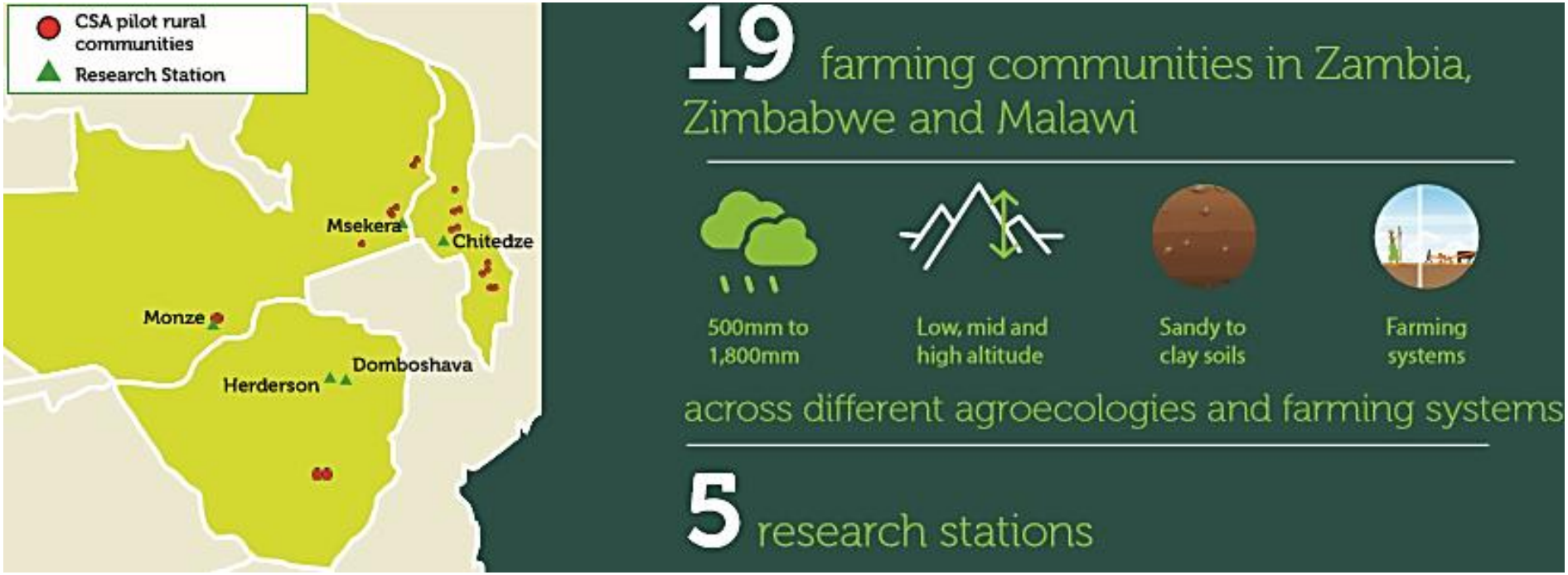
***Adaptation to Climate Change for Smallholder Rural Areas (ACCRA) Project funded by GIZ/CCARDESA***

- Undertake a climate change **Vulnerability Assessment**
- **Piloting** CSA technologies on-farm
- **Prioritization** of CSA technologies
- **Feasibility** study
- Development of out-scaling **Proposals** for CSA scaling

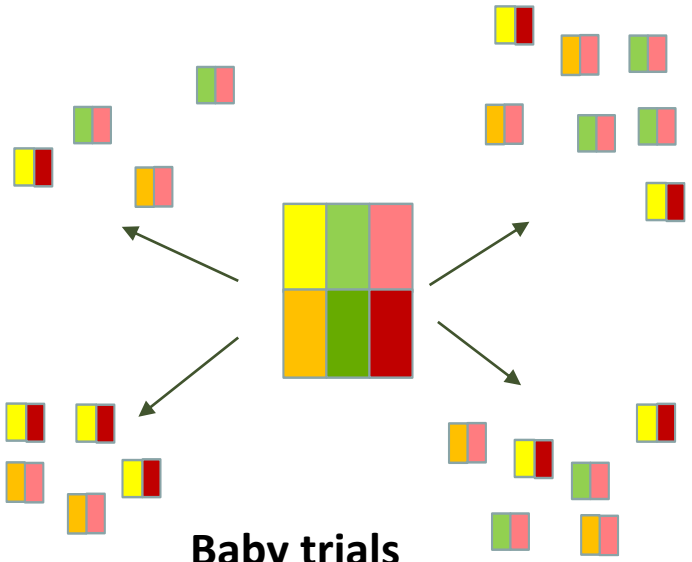
# Vulnerability assessment - process



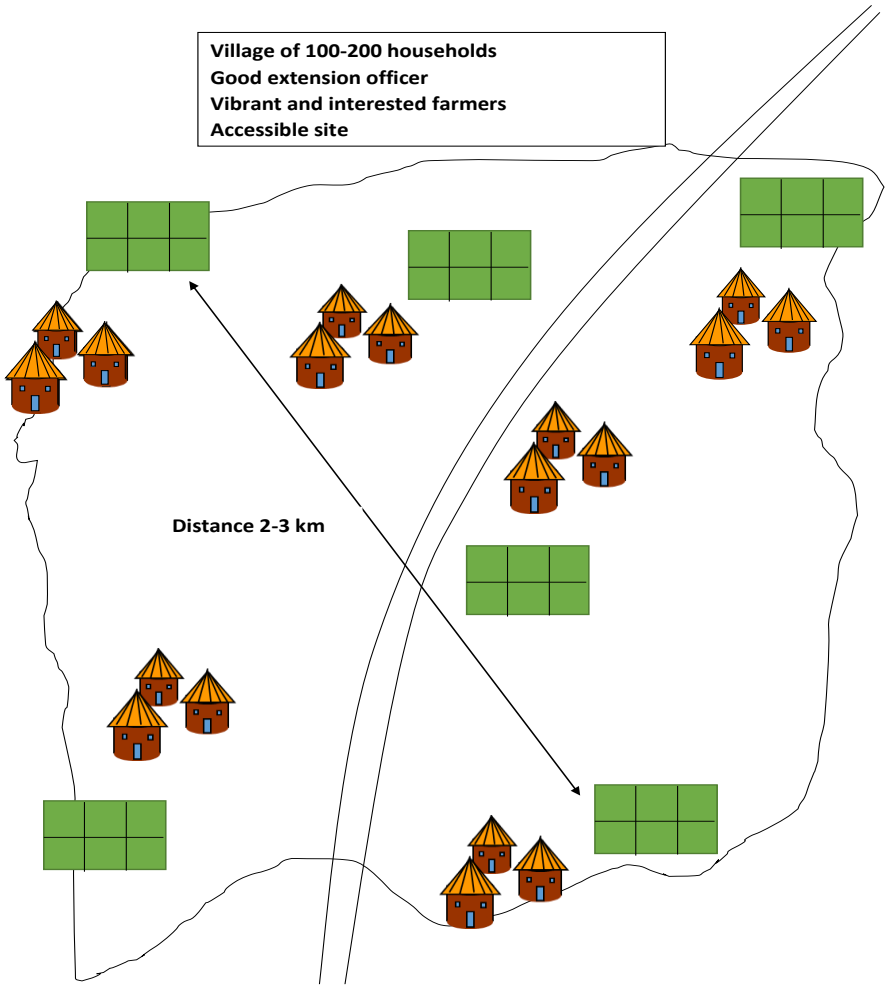
# Piloting in CSA in on-farm communities of Southern Africa



# Cluster villages and "Mother and Baby" trials



Baby trials




Mother trials

# Maize-legume rotation under CA with Pigeonpea Alley Cropping

# Prioritization of CSA technologies

## Process:

- Local meetings with key stakeholder in target communities
- Regional meeting in Lusaka using the GIZ tool
- Ranking based on a ranking matrix

| Southern MAL Adaptation option | Effective ness | Cost | Feasibility for Farmers | Political/ social acceptance | Relative speed to benefit | No regret potential | Alignement to donor support | Alignement with Policy | Sum of score | Rank | weighted rank | Mitigation co-benefit | Gender Sensitivity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| InterCropping | 5 | 3 | 5 | 5 | 4 | 4 | 5 | 5 | **36** | **4.50** | **4.35** | + | + |
| Crop Diversification | 5 | 3 | 4 | 5 | 4 | 5 | 5 | 5 | **36** | **4.50** | **4.25** | 0 | + |
| DT Vars | 5 | 2 | 3 | 4 | 5 | 4 | 5 | 5 | **33** | **4.13** | **3.85** | 0 | 0 |
| CA | 4 | 3 | 4 | 4 | 2 | 4 | 5 | 5 | **31** | **3.88** | **3.6** | 0 | + |
| Organic Manure | 4 | 3 | 3 | 4 | 4 | 4 | 2 | 5 | **29** | **3.63** | **3.55** | - | 0 |
| Supplementary Irrigation | 5 | 1 | 2 | 4 | 5 | 5 | 5 | 5 | **32** | **4.00** | **3.55** | 0 | 0 |
| Cap Building | 4 | 1 | 5 | 4 | 1 | 3 | 5 | 5 | **28** | **3.50** | **3.15** | 0 | + |
| IPM | 3 | 1 | 2 | 3 | 4 | 4 | 3 | 4 | **24** | **3.00** | **2.7** | 0 | 0 |
| Agro Met Info Sharing | 2 | 1 | 4 | 4 | 2 | 2 | 4 | 5 | **24** | **3.00** | **2.55** | 0 | 0 |
| Small livestock production | 4 | 1 | 1 | 4 | 3 | 2 | 4 | 4 | **23** | **2.88** | **2.45** | - | + |
| Rainwater Harvest | 4 | 1 | 2 | 2 | 3 | 3 | 1 | 3 | **19** | **2.38** | **2.45** | 0 | - |
| Policy Implement | 2 | 1 | 2 | 3 | 1 | 2 | 5 | 5 | **21** | **2.63** | **2** | 0 | 0 |

# A Feasibility Study on Climate-Smart Agriculture Systems

**For an investment proposal we needed data on:**

- Agronomic performance
- Economic viability
- Environmental impact
- Social impact (gender)

# Conservation agriculture: A climate-smart agriculture system:

- Minimal soil movement
- Surface crop residue retention
- Diversification through crop rotations, intercropping and green manures








*Maize-soybean rotation*

*Groundnuts under CA*

*Cowpeas under CA*

*Maize under CA*

*Maize-Gliricidia intercropping*


*Maize-groundnut rotation*

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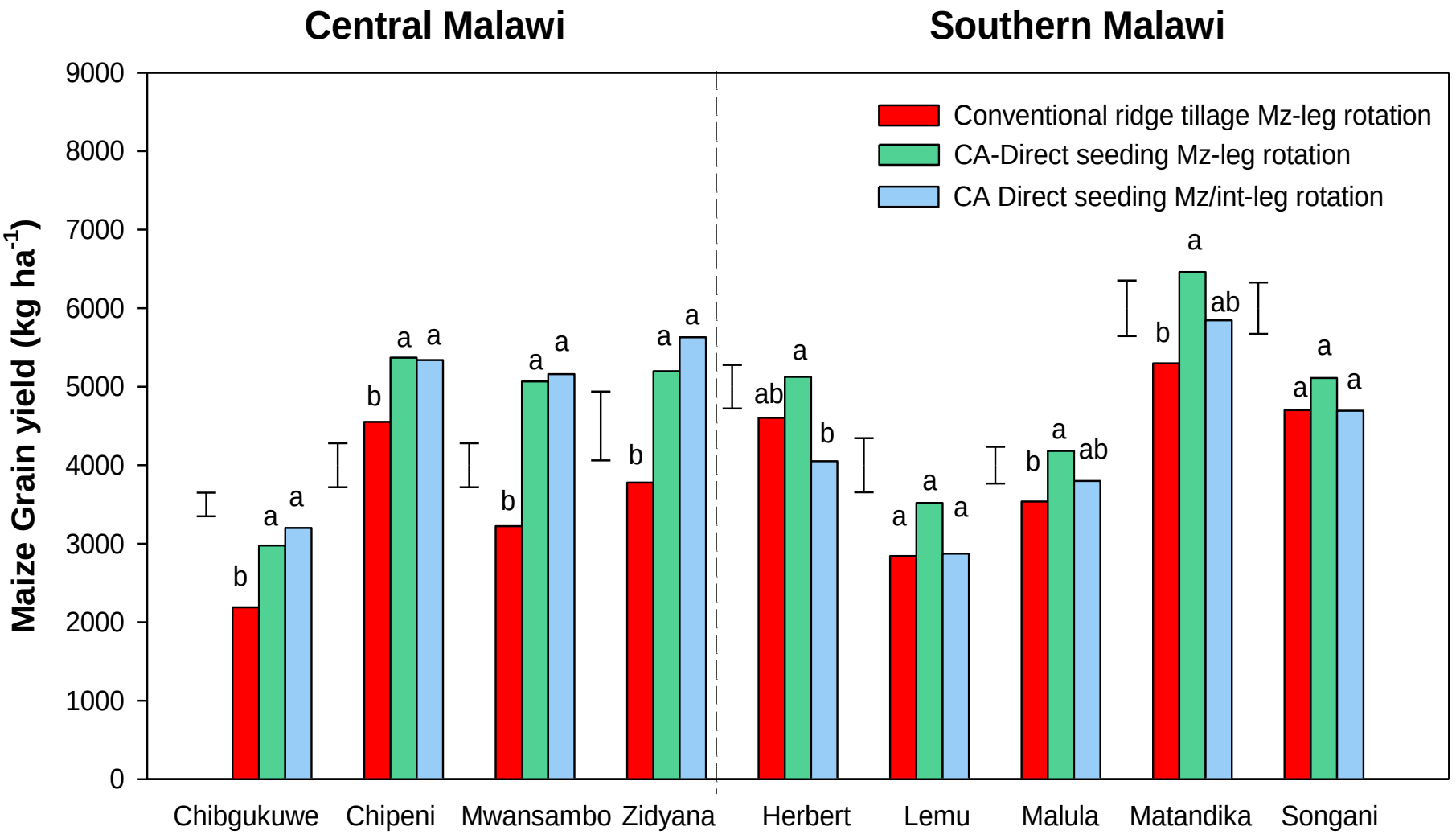
# Why focus on Conservation Agriculture?

- Combines all positive technologies **prioritized above**
- CA can help to **adapt production** to climate variability and change ….!
- CA is more **water-, nutrient-, and energy-use-efficient**
- CA improves the **productivity** of current farming systems
- Availability of **long-term data** to do the study

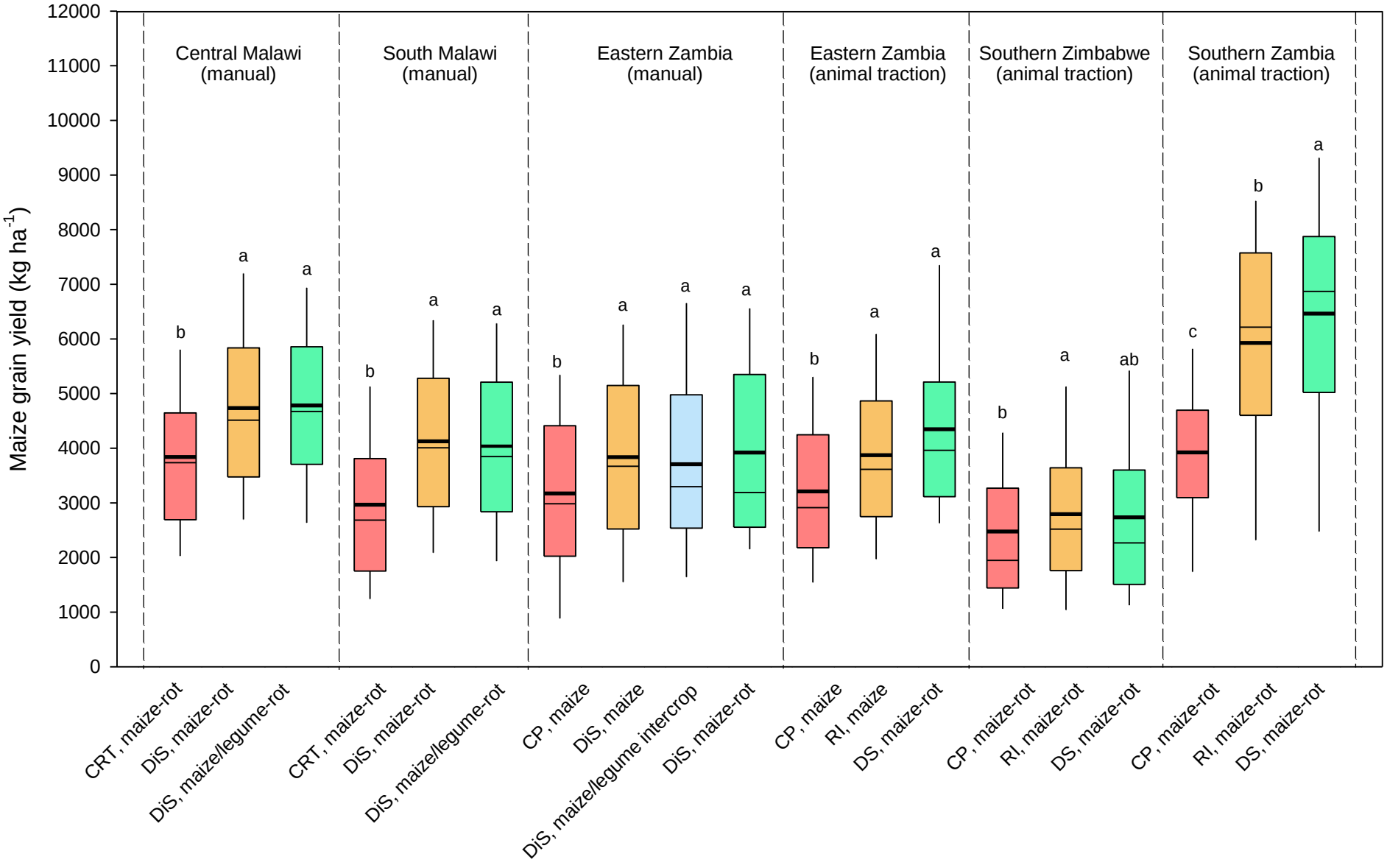
# Productivity benefits – On-farm pilots in Malawi, 2019



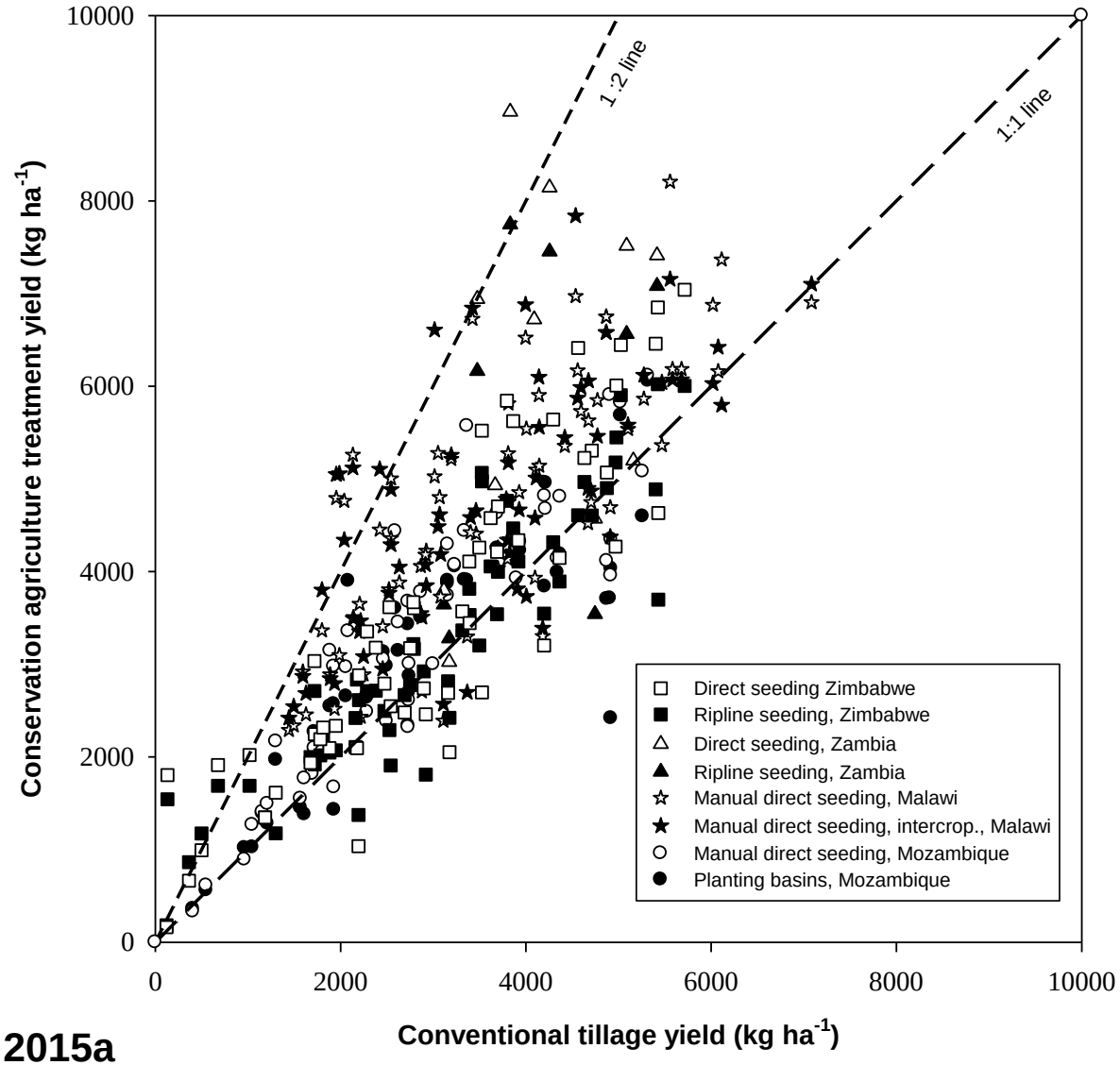
# Climate-smart agriculture in action!

# Women empowerment!

# Productivity benefits – long-term

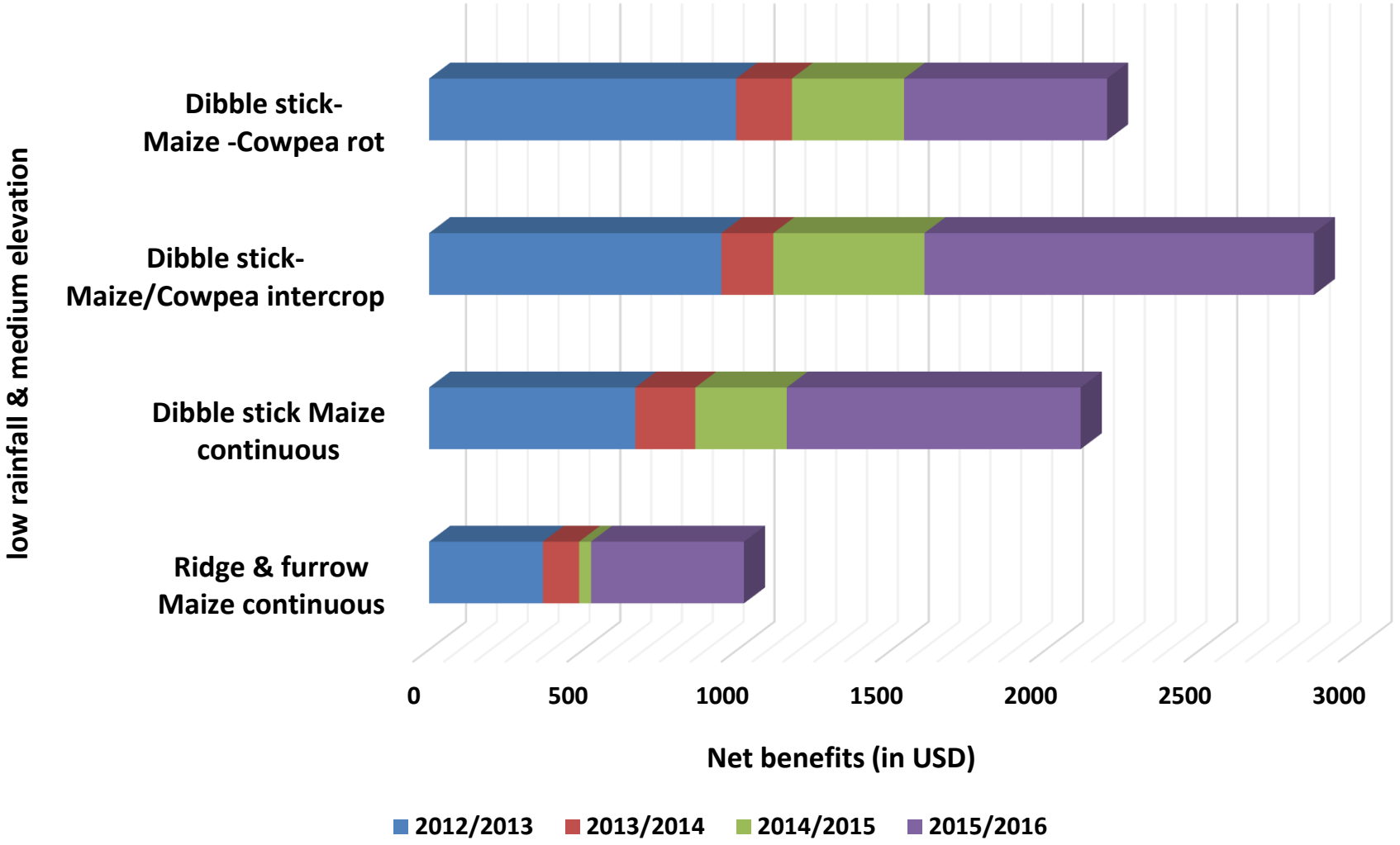


# Regional yield response to CA in southern Africa from 2005-2016



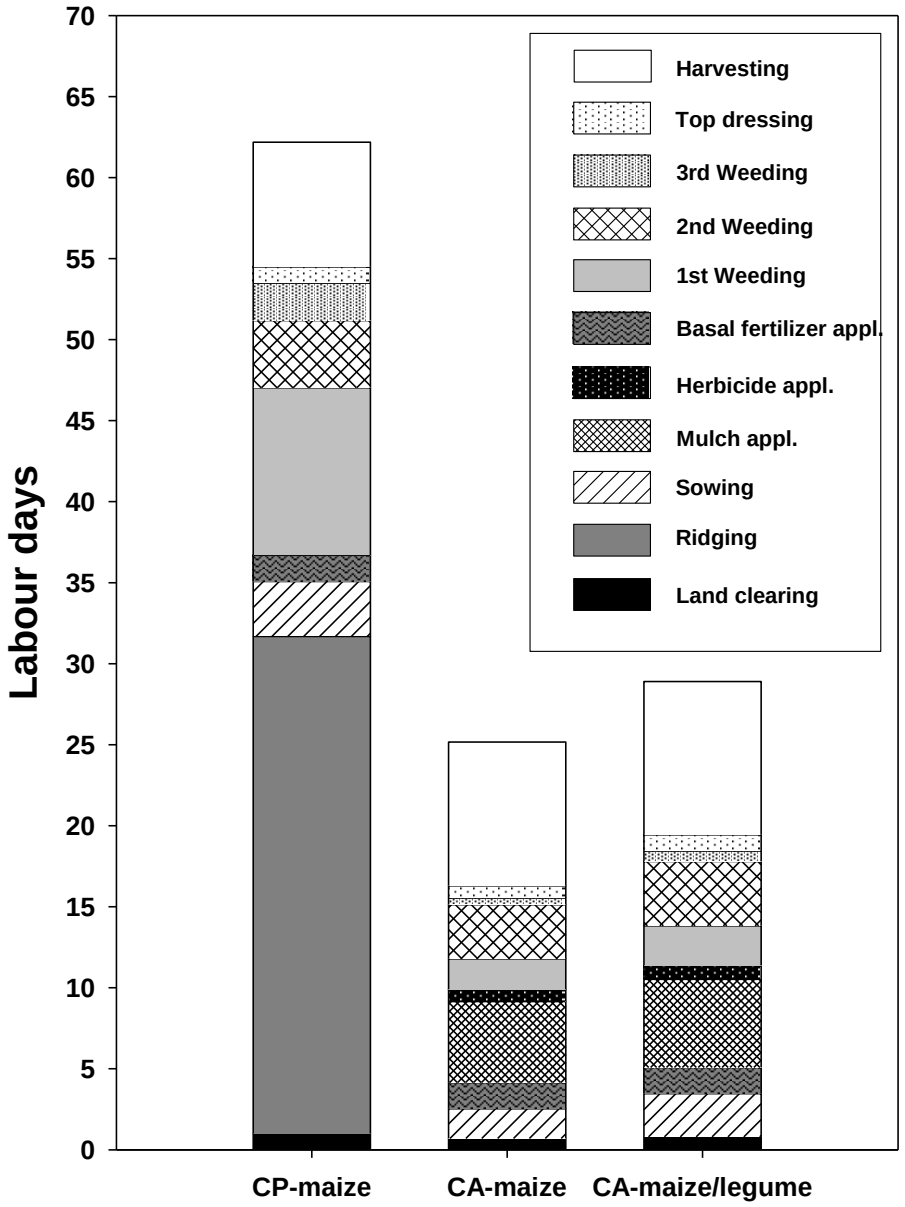

**Thierfelder et al. 2015a**

# Manual Sustainable Intensification Practices - Net Benefits (2012-2016), Eastern Zambia




Mutenje et al. 2016

# Labour reduction – a key benefit!




Thierfelder et al. 2015b

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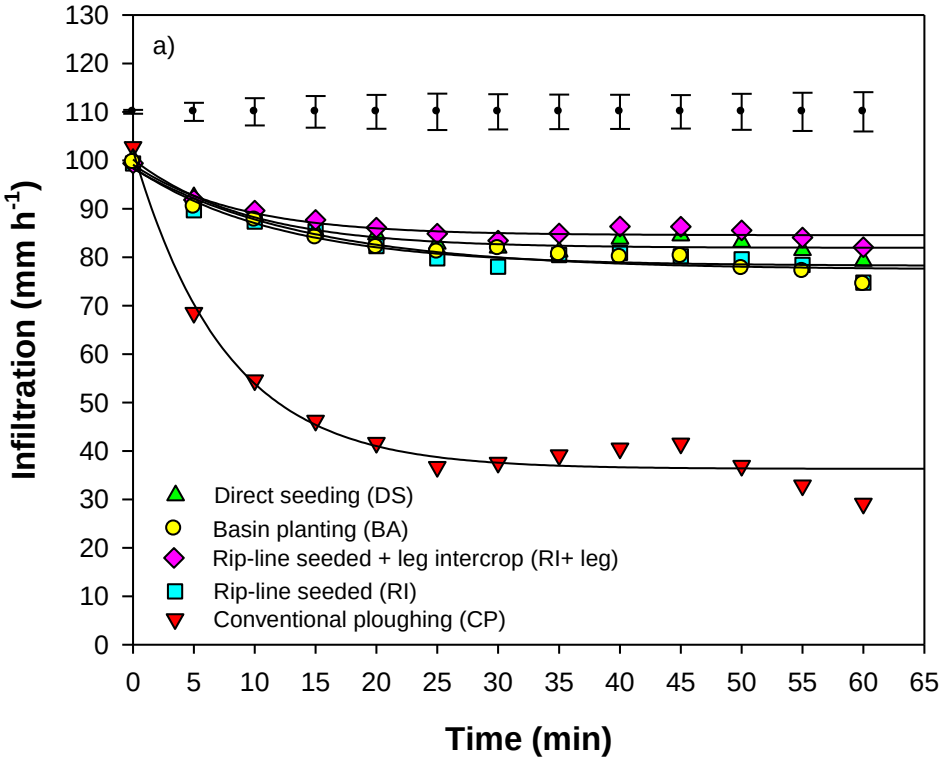
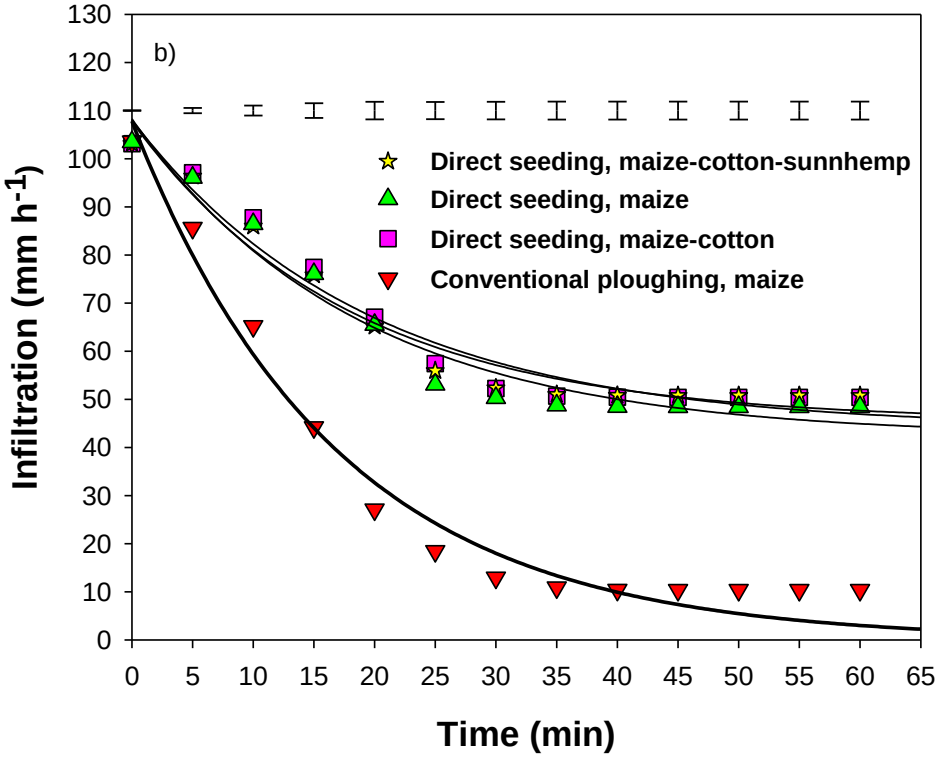
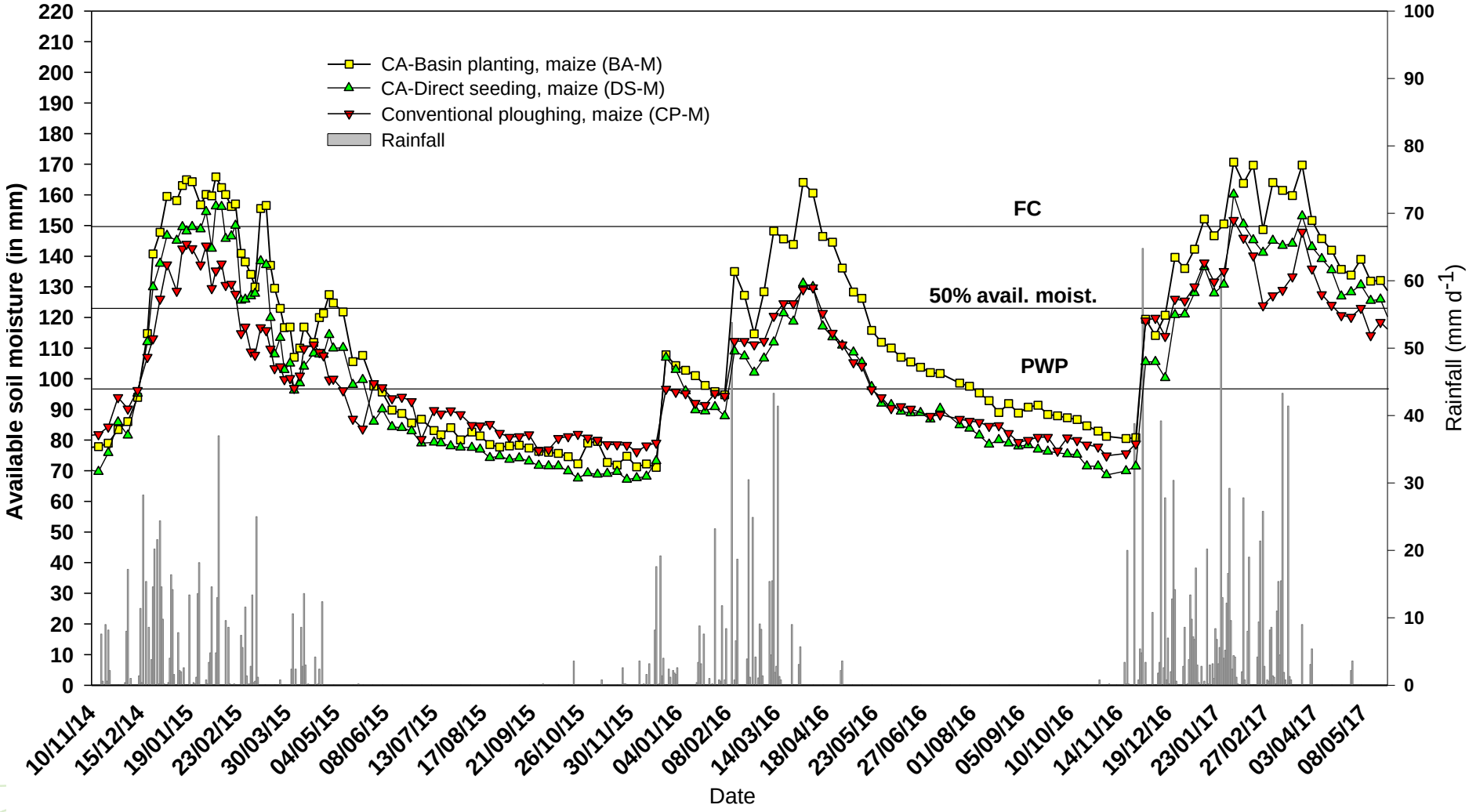
# Environmental benefits – improved Water Infiltration

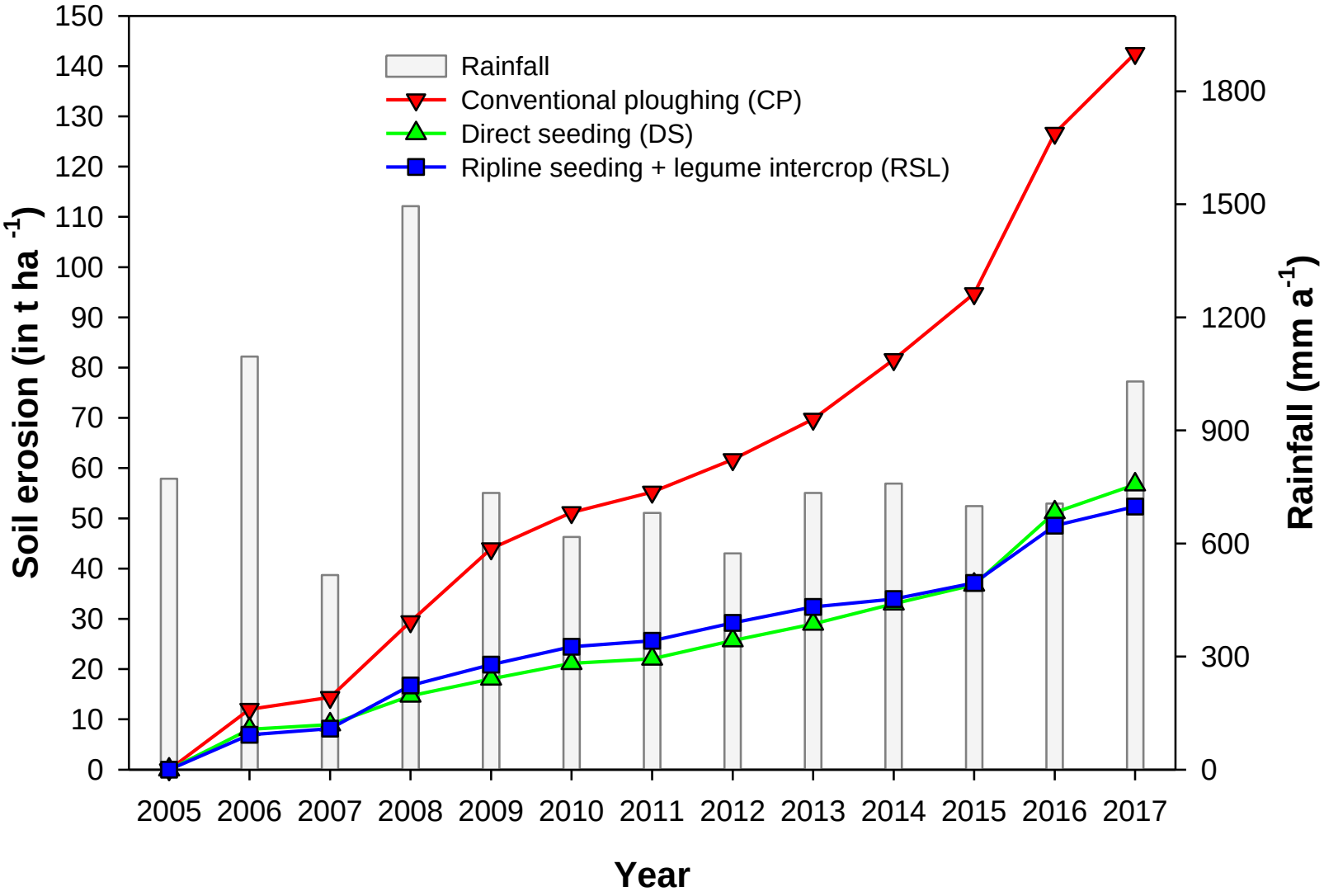


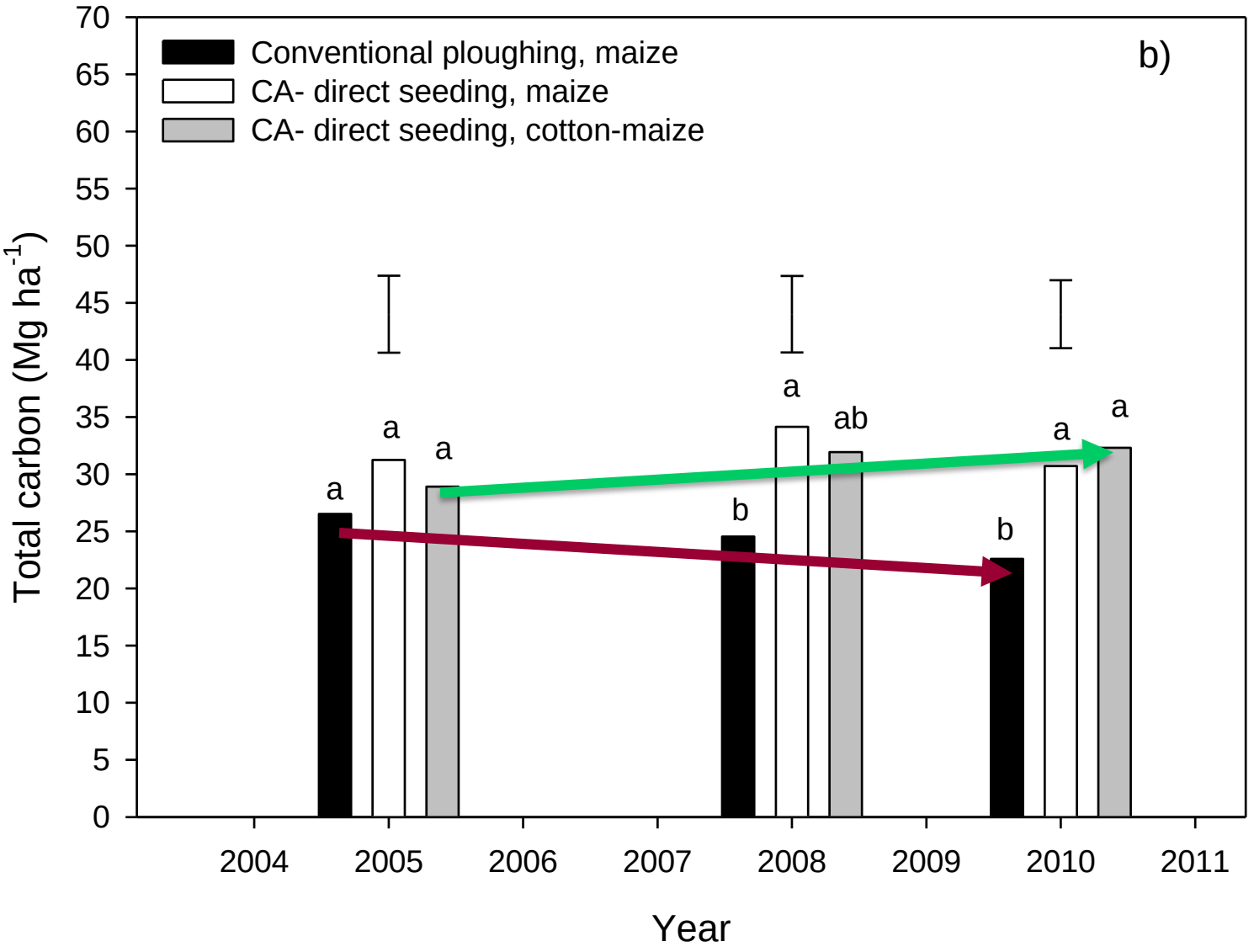
# Environmental benefits – increased Soil Moisture

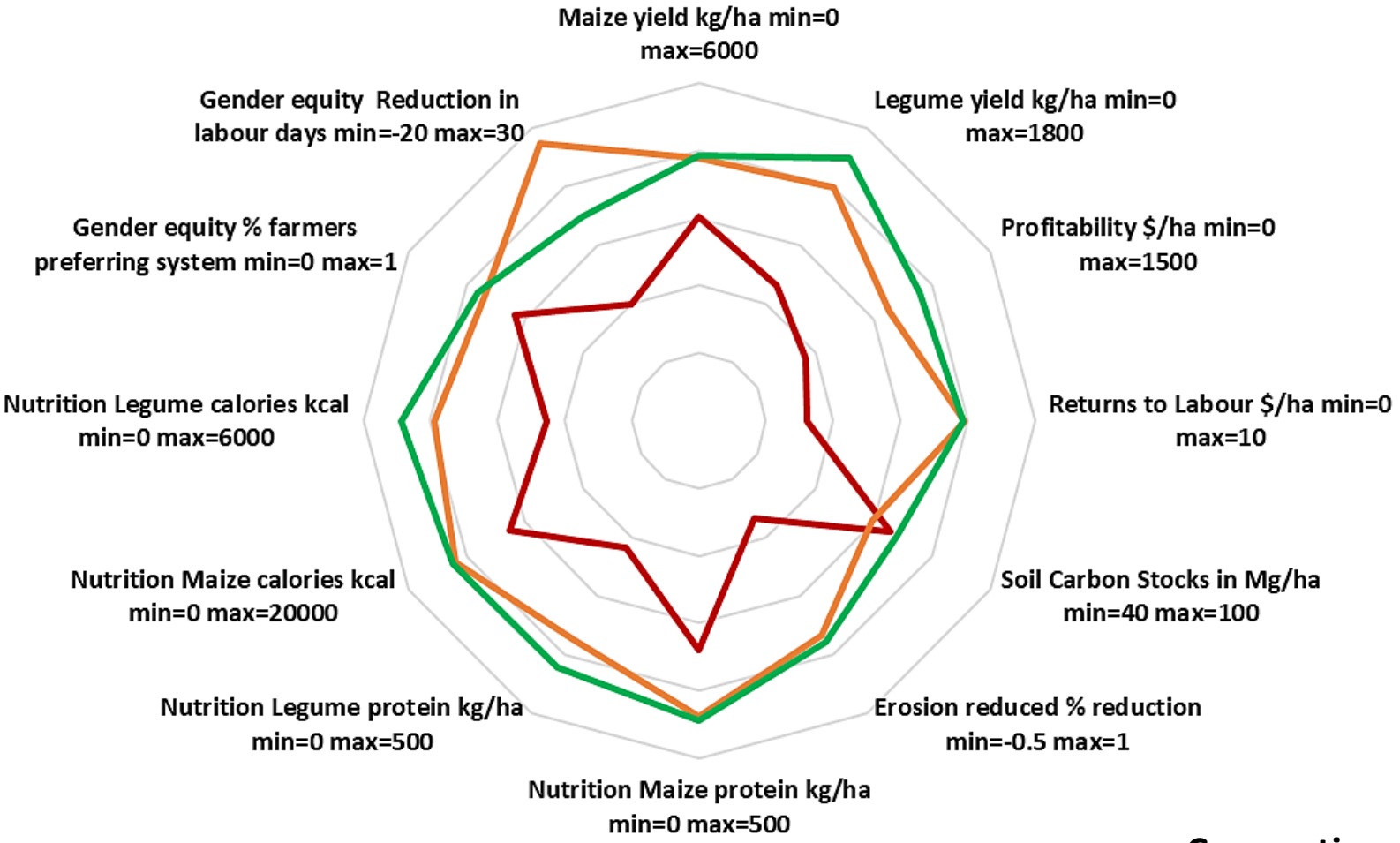


# Environmental benefit – reduced Soil Erosion



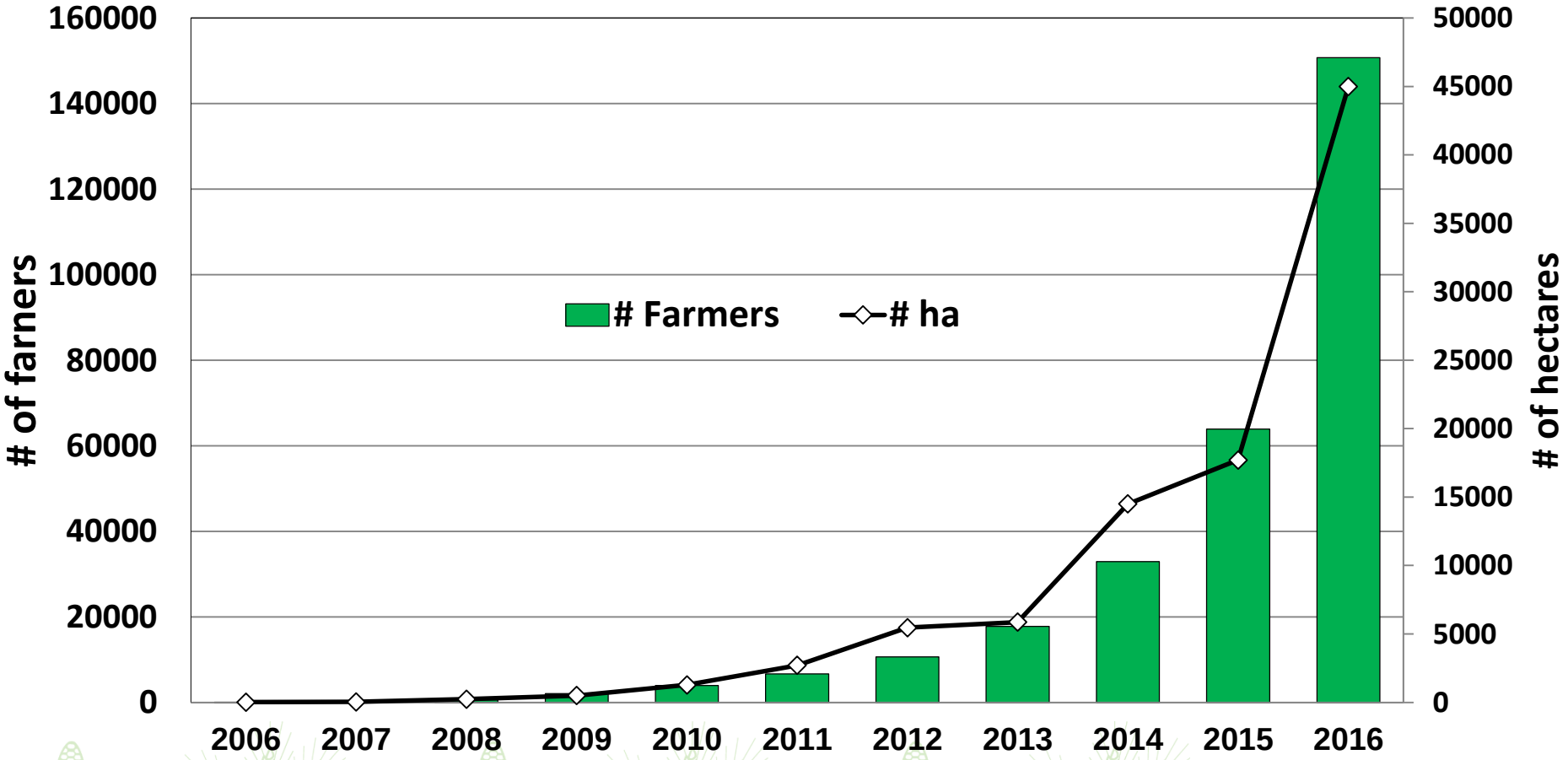
# Environmental benefit – gradual increase in soil carbon




Maize yield kg/ha min=0 max=6000
Legume yield kg/ha min=0 max=1800
Profitability $/ha min=0 max=1500
Returns to Labour $/ha min=0 max=10
Soil Carbon Stocks in Mg/ha min=40 max=100
Erosion reduced % reduction min=-0.5 max=1
Nutrition Maize protein kg/ha min=0 max=500
Nutrition Legume protein kg/ha min=0 max=500
Nutrition Maize calories kcal min=0 max=20000
Nutrition Legume calories kcal min=0 max=6000
Gender equity % farmers preferring system min=0 max=1
Gender equity Reduction in labour days min=-20 max=30
Conventional tillage
CA
CA+legume


Planted same day, same fertilizer level, same variety – but different cropping system

# Farmers practicing CA with TLC in Malawi – initiated with CIMMYT in 2005 but supported by many funders!




Source: Bunderson TLC, 2016

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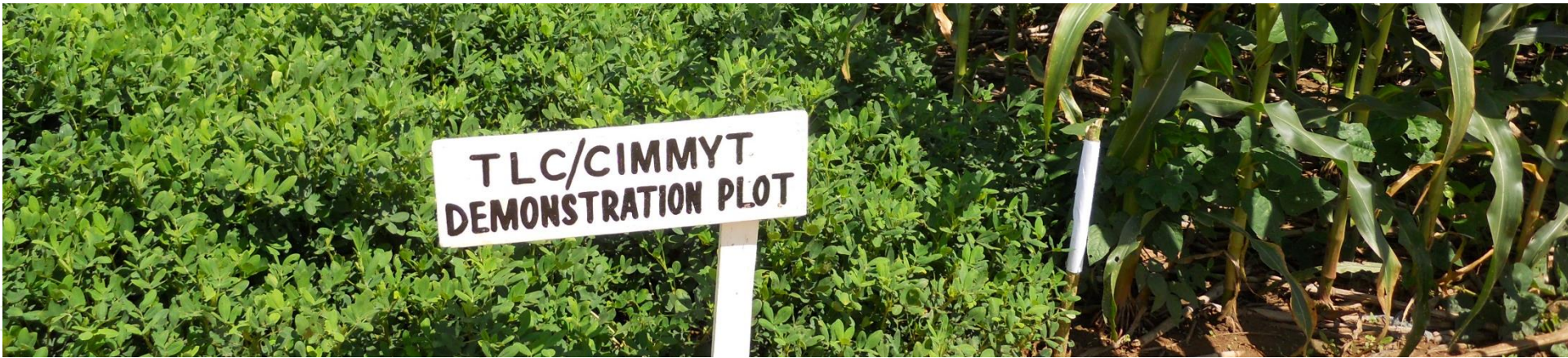
# CA Adoption in Zambia and Malawi- with an increasing trend….!

| Country | Area under CA (ha) | Area under CA (ha) |
|---|---|---|
| | **2013** | **2018** |
| Malawi | 65,000 | 210,000 |
| Zambia | 200,000 | 316,000 |

**Source: Kassam et al. 2015; 2018**

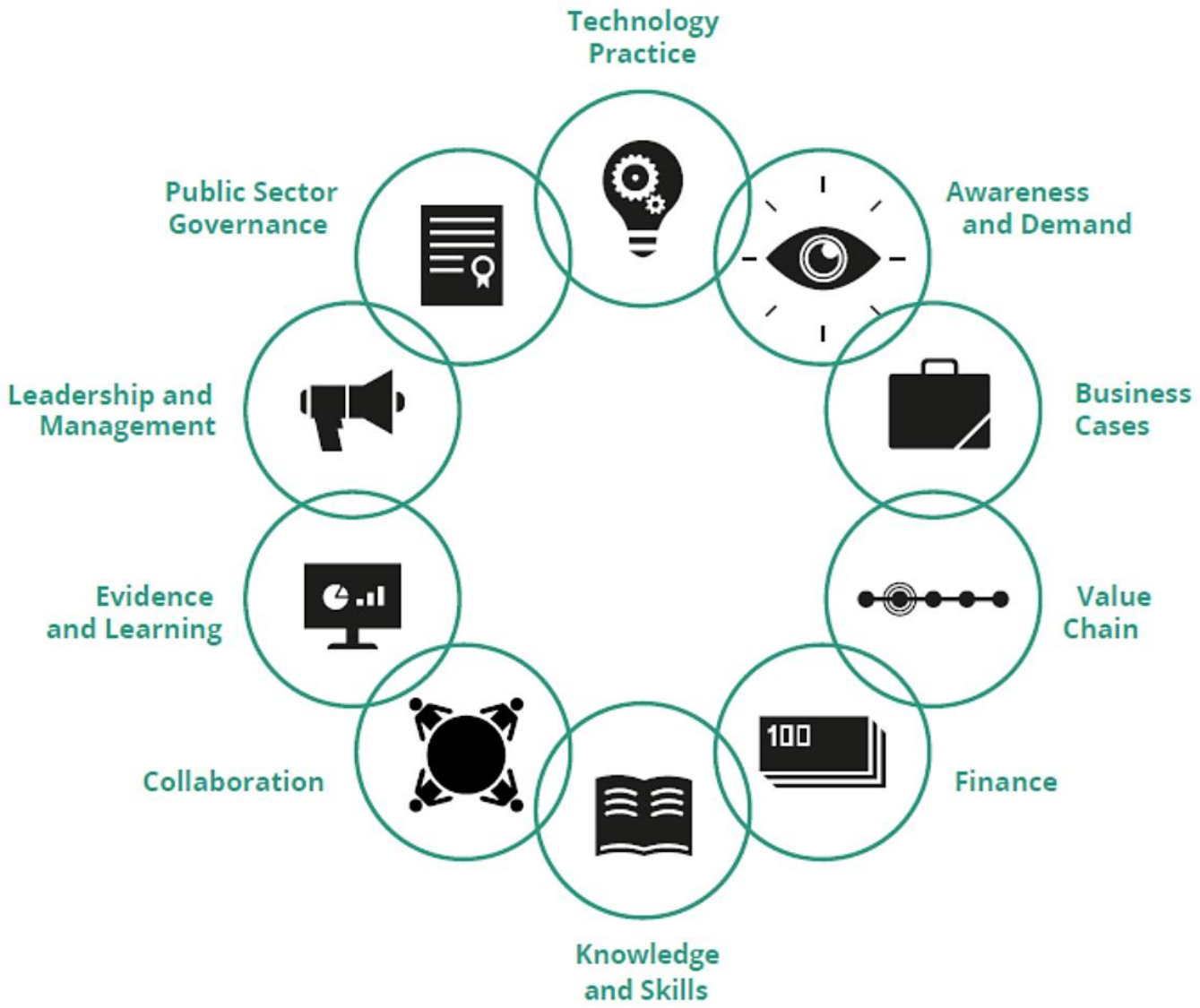
# Some pertinent challenges ...

- **Residues:** How can we feed both livestock and crops?
- **Weeds** and their control – a major challenge if no herbicides are used
- Lack of **fertilizer use –** what are the alternatives?
- Limited crop **diversification** – too much focus on maize
- Lack of **evidence** and data taking – believe in myths



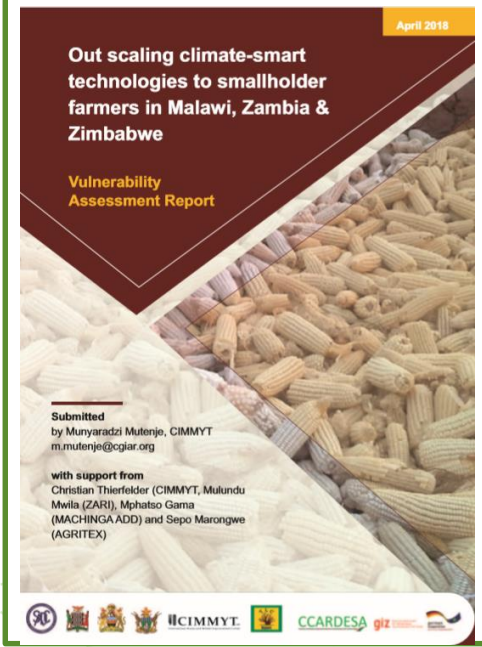
- **Targeting** the wrong systems to the wrong farmers
- Donor driven **adoption -** one-size fits-all approaches
- Low adoption – lack of **understanding** of underlying issues
- Ignoring farmers rationale and **decision making**
- The need for new **knowledge and co-development** of technologies

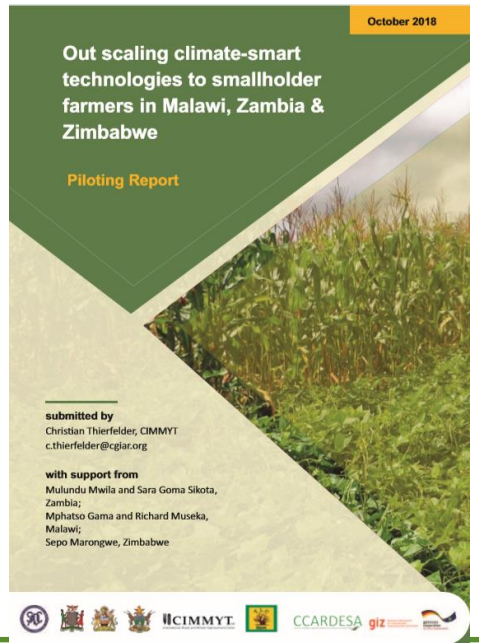
# Scaling is more than the technology

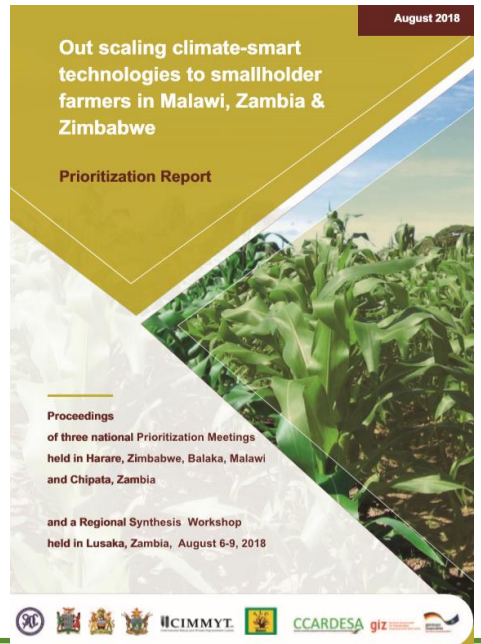


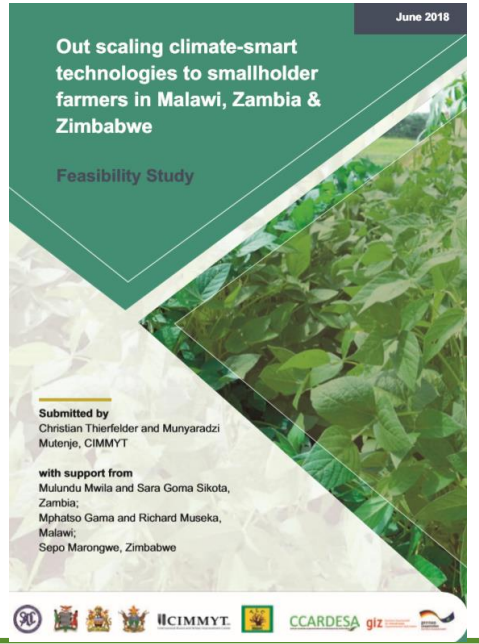
**Project results** have been summarized in 4 project reports in contemporary design –

# This is our Business Case!

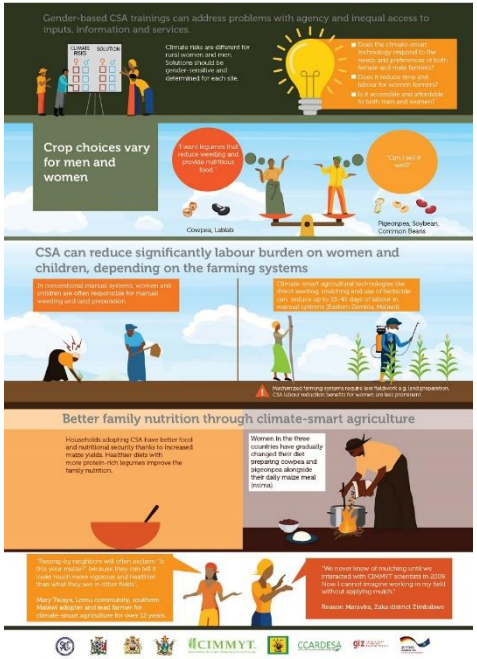



2. Feasibility study of Climate-Smart Agriculture for rural communities in southern Africa: the approach.
"A Climate-Smart Agriculture (CSA) innovation is a technology or practice that increases farm productivity and profitability; helps farmers cope with negative effects of climate change; and builds resilience, and mitigate climate change by reducing greenhouse gas emissions and/or increase carbon sequestration in soils.
19 farming communities in Zambia, Zimbabwe and Malawi
across different agroecologies and farming systems
5 research stations
Can we scale out CSA ?


Gender-based CSA trainings can address problems with agency and inequal access to inputs, information and services.
Climate risks are different for rural women and men. Solutions should be gender-sensitive and determined for each site.
Crop choices vary for men and women
CSA can reduce significantly labour burden on women and children, depending on the farming systems
Better family nutrition through climate-smart agriculture
Households adopting CSA have better food and nutritional security thanks to increased maize yields. Healthier diets with more protein-rich legumes improve the family nutrition.
Women in the three countries have gradually changed their diet preparing cowpea and pigeonpea alongside their daily maize meal (nsima).
"Passing-by neighbors will often exclaim: 'Is this your maize?', because they can tell it looks much more vigorous and healthier than what they see in other fields'.
Mary Twaya, Lemu community, southern Malawi adopter and lead farmer for climate-smart agriculture for over 12 years.
"We never knew of mulching until we interacted with CIMMYT scientists in 2009. Now I cannot imagine working in my field without applying mulch."
Reason: Manvitsi, Zaka district Zimbabwe
CIMMYT
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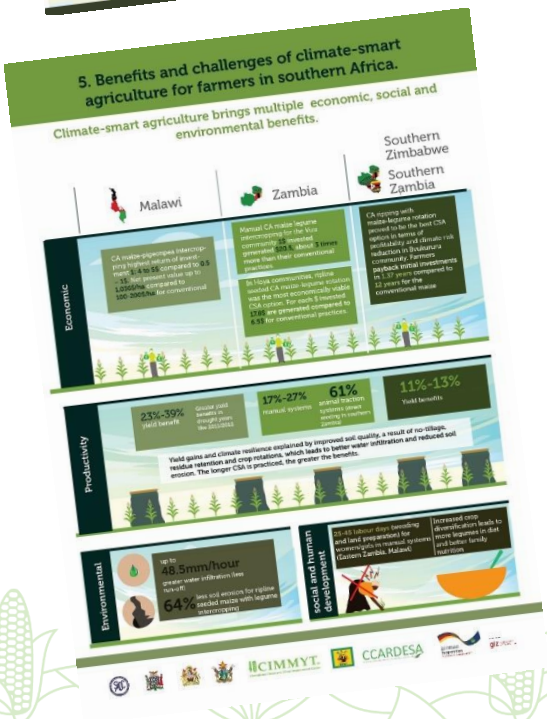
6. Gender-sensitive climate-smart agriculture in southern Africa
Malawi
Zambia
Zimbabwe
Maize yield
25%
49%
17%
There is a gender gap in agricultural productivity. It makes women farmers less climate-resilient
17.8%
1%
5.3%
Contribution of different factors to the gender gap in agricultural productivity in Malawi
45.2%
28.4%
CSA PATHWAYS TO REDUCE GENDER GAP IN AGRICULTURAL PRODUCTIVITY


5. Benefits and challenges of climate-smart agriculture for farmers in southern Africa.
Climate-smart agriculture brings multiple economic, social and environmental benefits.
Malawi
Zambia
Southern Zimbabwe
Southern Zambia
Economic
Productivity
Environmental
social and human development
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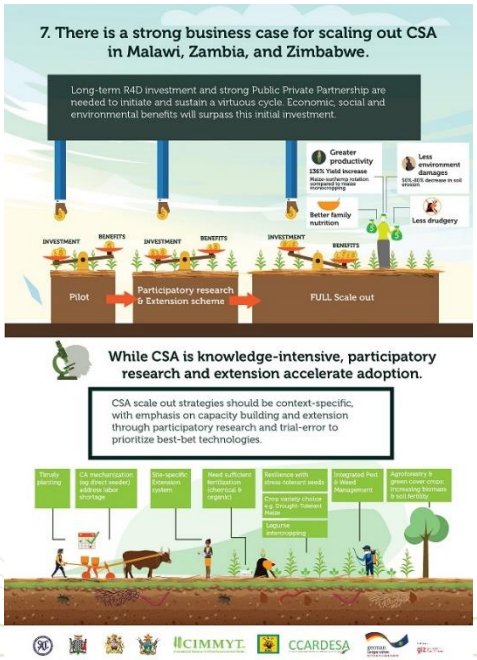
7. There is a strong business case for scaling out CSA in Malawi, Zambia, and Zimbabwe.
Long-term R4D investment and strong Public Private Partnership are needed to initiate and sustain a virtuous cycle. Economic, social and environmental benefits will surpass this initial investment.
Greater productivity
Less environment damages
Better family nutrition
Less drudgery
INVESTMENT
BENEFITS
Pilot
Participatory research & Extension scheme
FULL Scale out
While CSA is knowledge-intensive, participatory research and extension accelerate adoption.
CSA scale out strategies should be context-specific, with emphasis on capacity building and extension through participatory research and trial-error to prioritize best-bet technologies.
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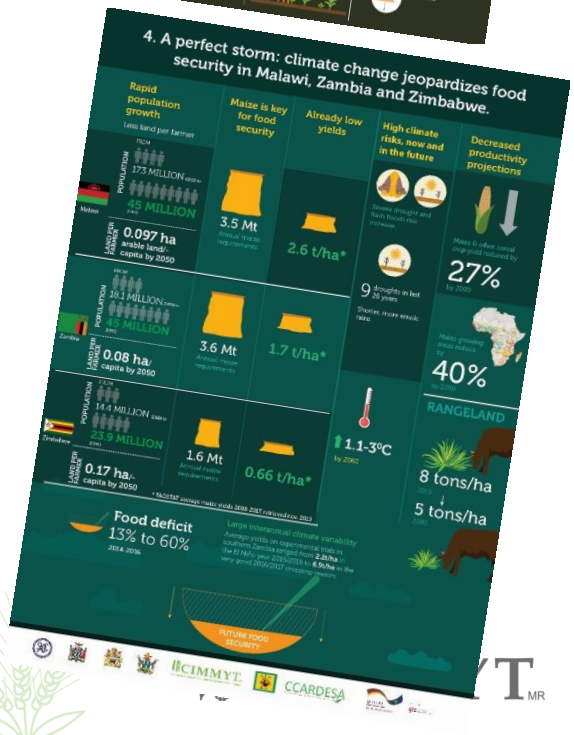
4. A perfect storm: climate change jeopardizes food security in Malawi, Zambia and Zimbabwe.
Rapid population growth
Maize is key for food security
Already low yields
High climate risks, now and in the future
Decreased productivity projections
Malawi
Zambia
Zimbabwe
45 MILLION
0.097 ha arable land/- capita by 2050
3.5 Mt
2.6 t/ha*
27%
40%
RANGELAND
8 tons/ha
5 tons/ha
0.08 ha/ capita by 2050
3.6 Mt
1.7 t/ha*
23.9 MILLION
0.17 ha/- capita by 2050
1.6 Mt
0.66 t/ha*
1.1-3°C
Food deficit 13% to 60%
FUTURE FOOD SECURITY
CIMMYT
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# Several regional and country proposals have been developed for southern Africa

- **Work package 1:** Scaling out climate-smart agriculture with smallholders in a community-based approach
- **Work Package 2:**Incentivising the supply side to invest into climate-smart agriculture
- **Work Package 3:** Knowledge generation and dissemination
- **Work Package 4:** Creating an enabling policy environment

# YES we CAN!

**Participatory vulnerability assessment:** what are the risks, exposure/sensitivity and existing coping mechanisms?


**Prioritization : Identification of feasible CSA best-bet options to scale for better adaptation**

- Stakeholder meetings (3) to select 2 best-bet CSA options to compare with conventional system in term of productivity, adaptation and mitigation
- potential.

Regional decision-maker workshop in Zambia, 2018 with NARS research and extension directors; and other stakeholders using GIZ Climate proofing tool per agroecological zone


**Long-term on-farm and station trials** to understand benefits and trade-offs of CSA technologies/practices in variable climate (productivity, income, social, environment)

**Quantity Soil Carbon?**

Pilot study to test adaptability of new CSA system (doubled legume rotation) & CSA mitigation potential