Greener food production in Africa:

resilient legumes and zonal management

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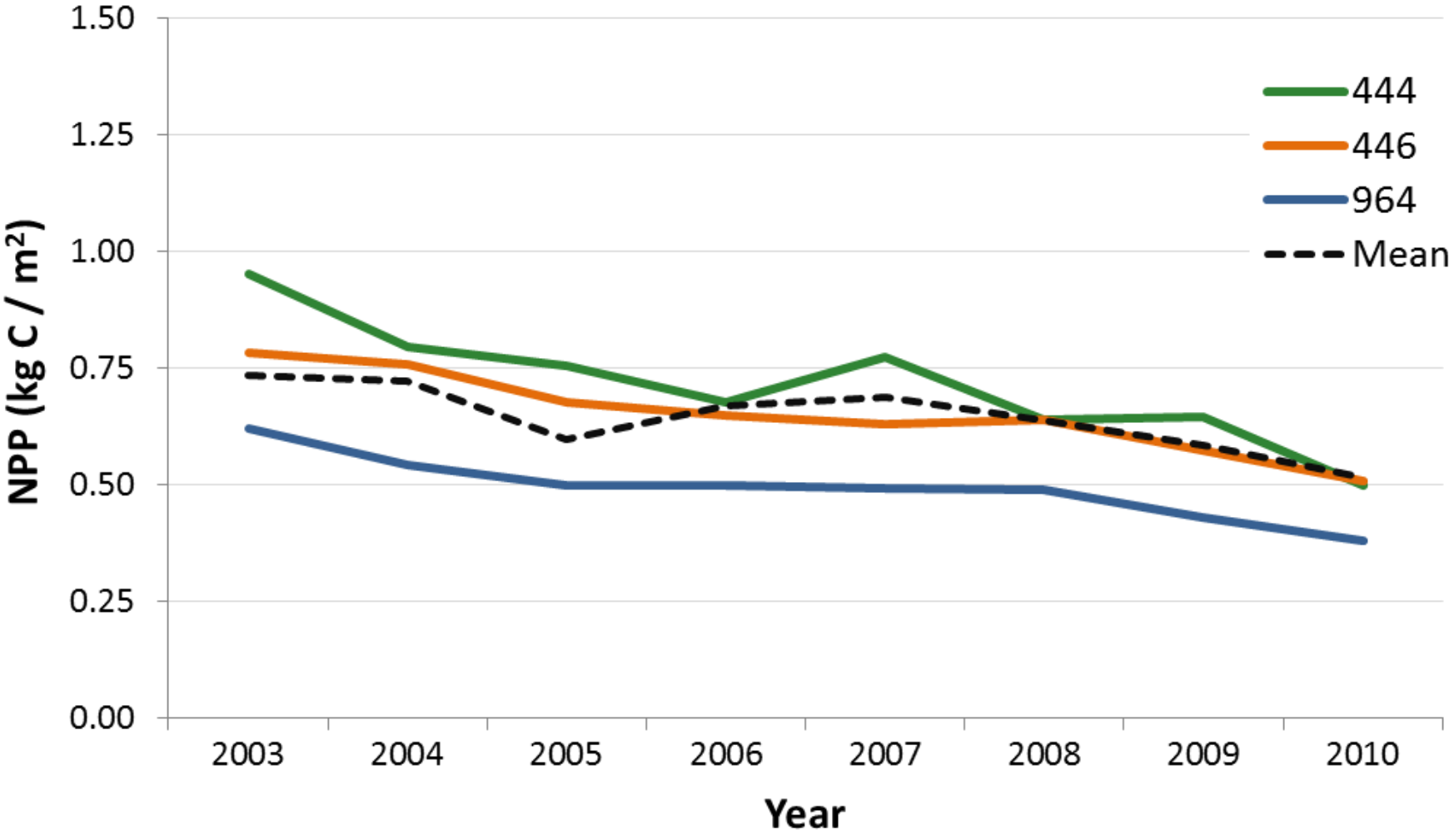
www.globalchangescience.org/eastafricanode

Problem #1: Resource degradation

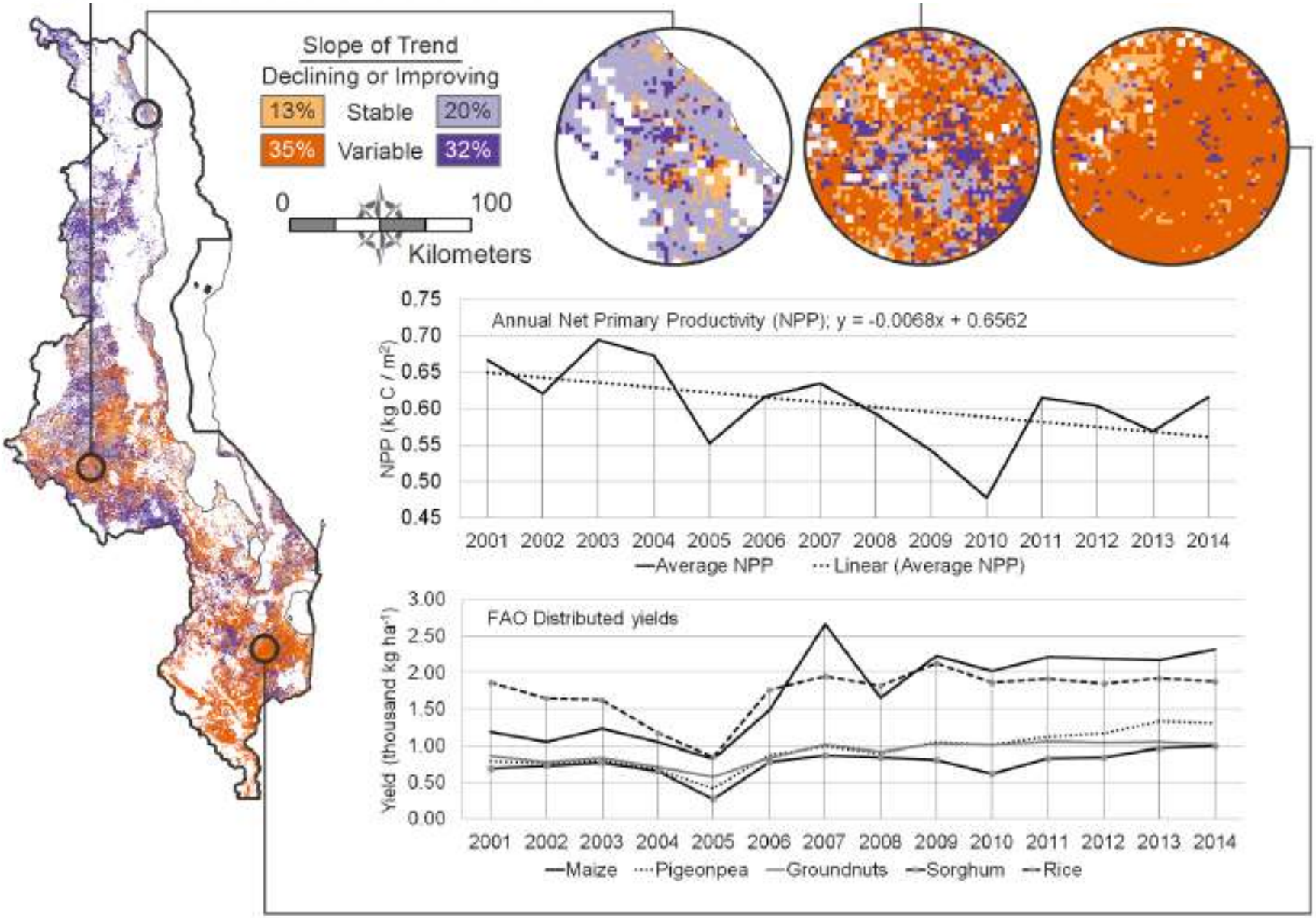
Downward spiral of soil degradation resulting in low yields, further decreasing SOM & increasing erosion AND… **reduced crop response**!

Problem #2: Increasing vulnerability

Malawi Remote Sensing Signal from Agricultural Lands



Messina, Peter & Snapp, Nature Plants, in press

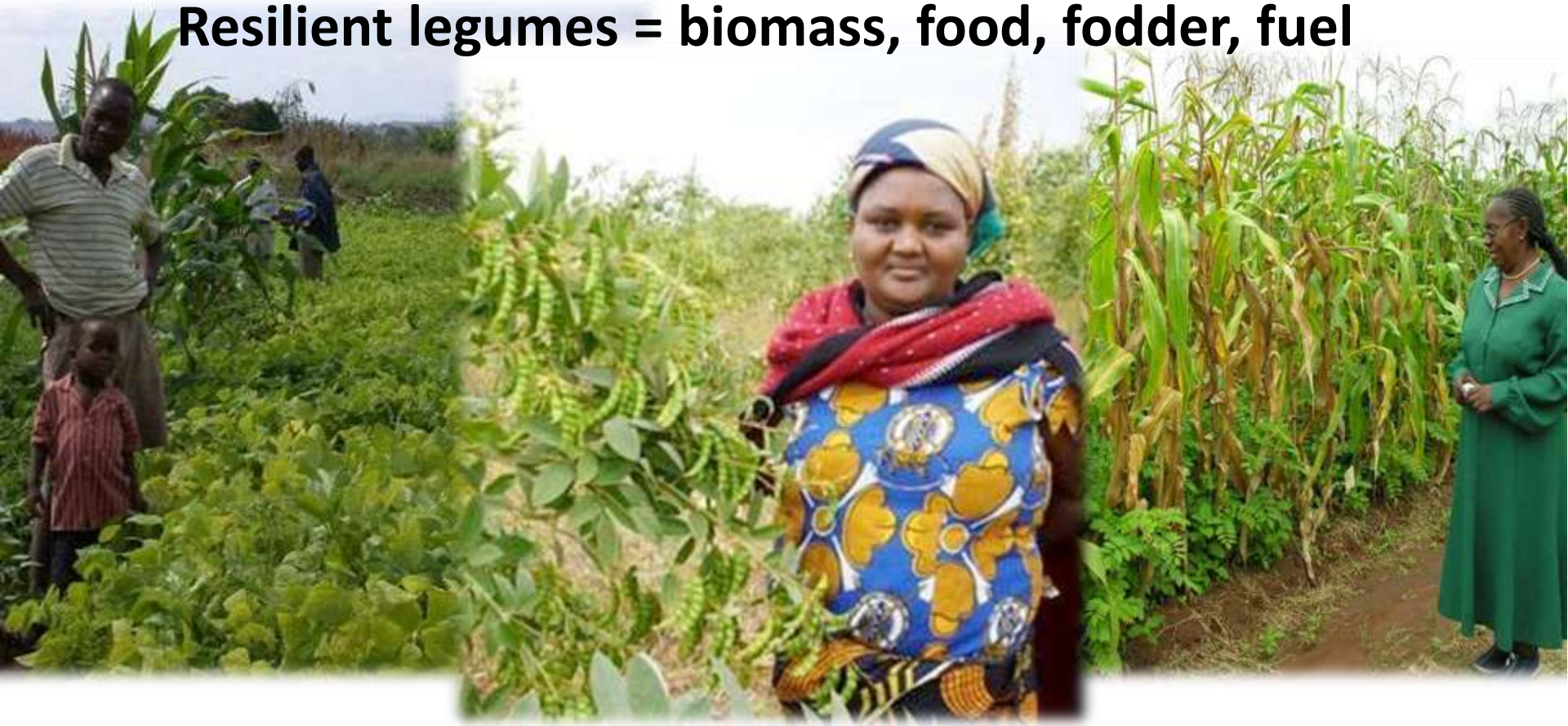


Messina, Peter & Snapp, Nature Plants, in press

Priority #1

Priority #1: legumes

Resilient legumes = biomass, food, fodder, fuel



Legumes are not all the same

Annual Pulse

Perennial

Long lived crop legumes = resilient

Resilient legumes

Legume best bet options

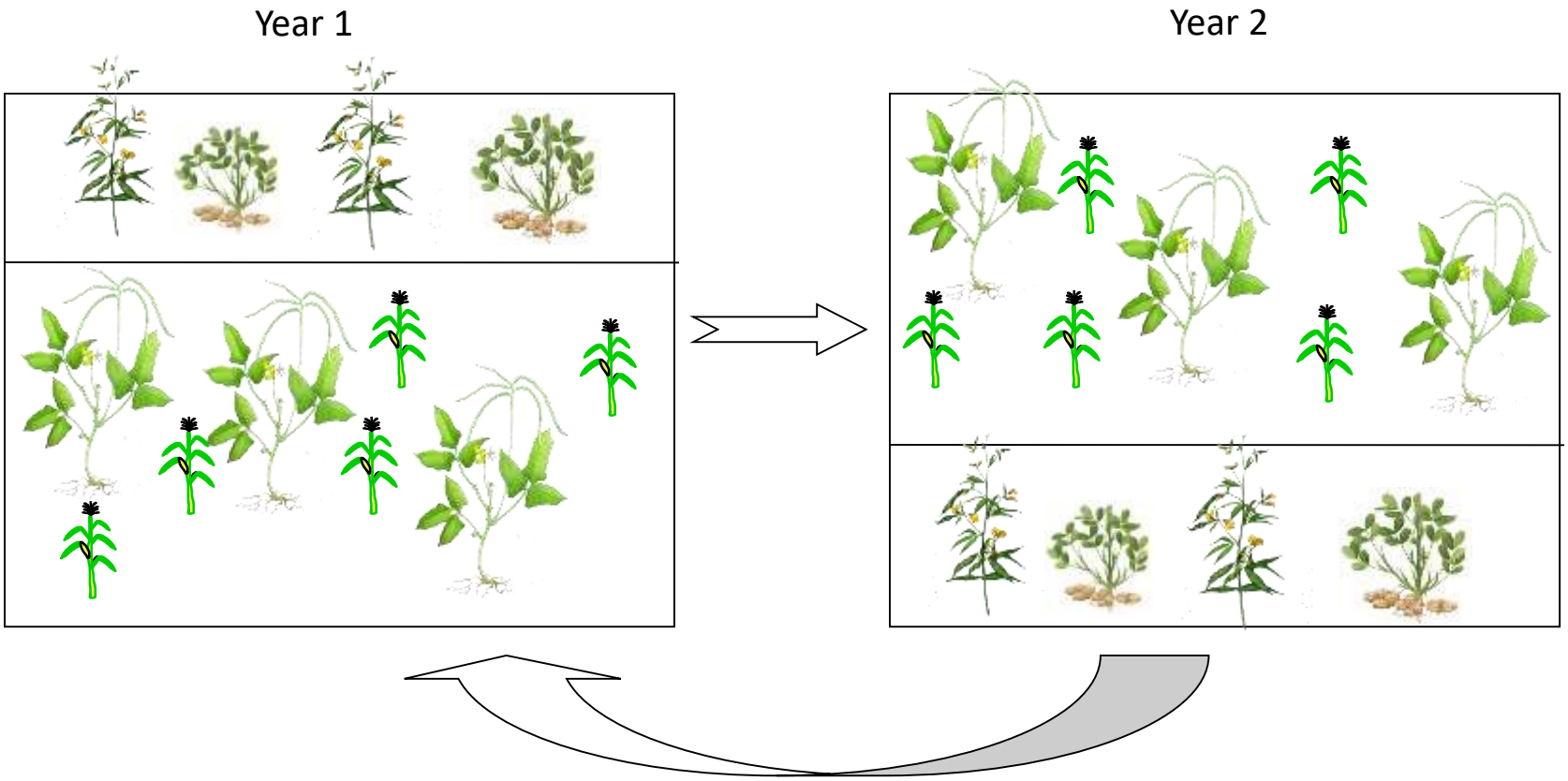
- Double row soybean, groundnut
- Doubled up legumes

Double Row Soybean: Africa RISING farmer

Year 2: Maize

Complementarity: Cereal + Legume

Short + Long-duration Legumes



Complementarity:
Short + Long-duration Legumes

Cowpea and Lablab Grow Very Well Together

- Cowpea and lablab have different growth habits and life cycles and grow well together
- When cowpea growth declined @ week 12, lablab growth accelerated and provided long-term groundcover
- Intercropping lablab with cowpea did not lower cowpea biomass production or yields

Arun Jani, ECHO
Howard Buffett Foundation

Complementarity:
Cereal + Long-duration Legume

Lablab
(*Lablab purpureus*)

W. Mariki, N. Miller,
A. Nord and team

Summary: Legume better bet options

- Double row soybean, groundnut (**market linked farmers**)

- Doubled up legumes (**resource poor farmers on marginal lands**): Released by Malawi government March, 2016

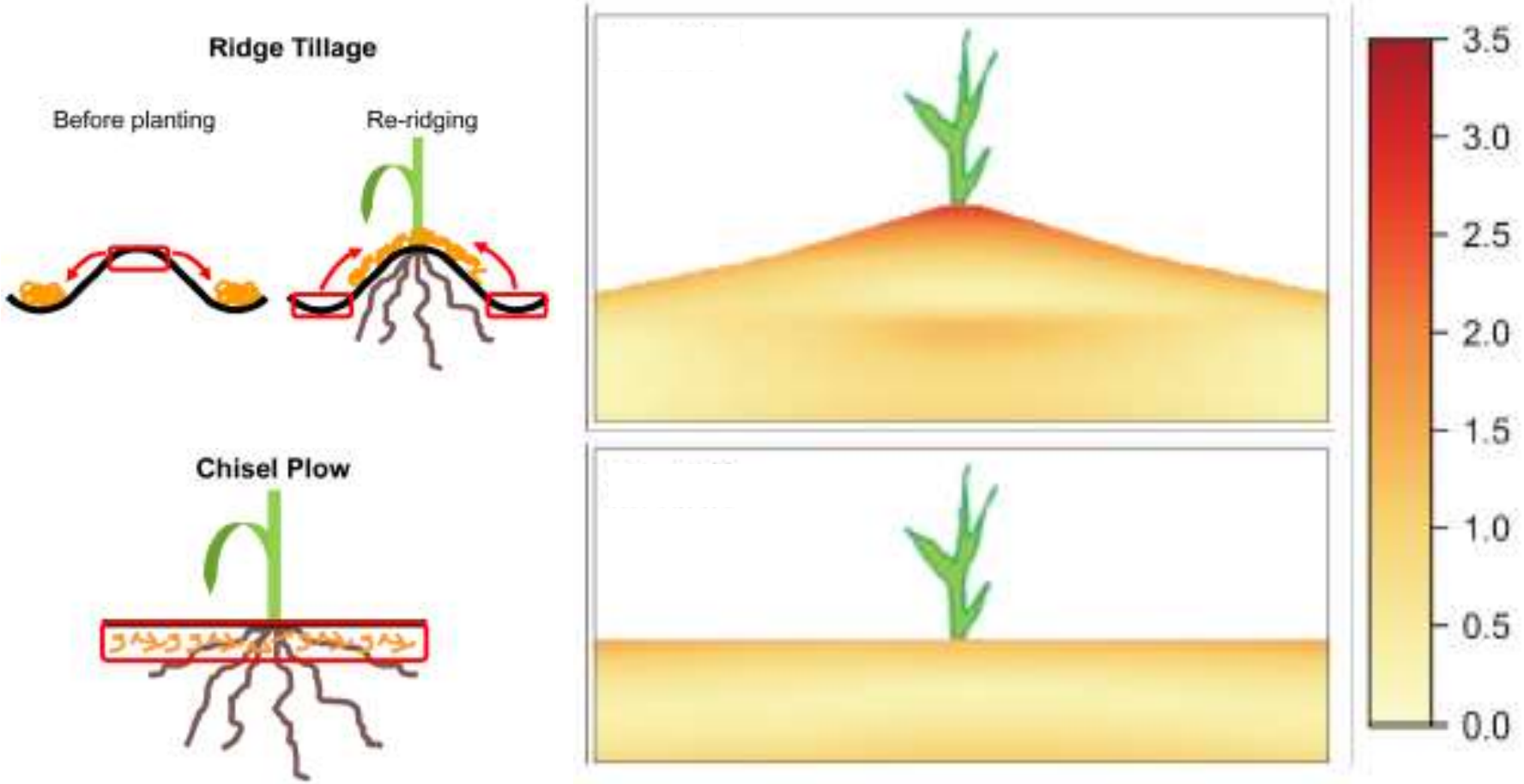
Priority #2

Zonal management

Priority #2

Zonal management: Permanent ridge tillage

Permanent ridge tillage



Kane et al., 2016 SSSA

Zonal management: ridge alignment

Zonal management: Tied ridges

Zonal management

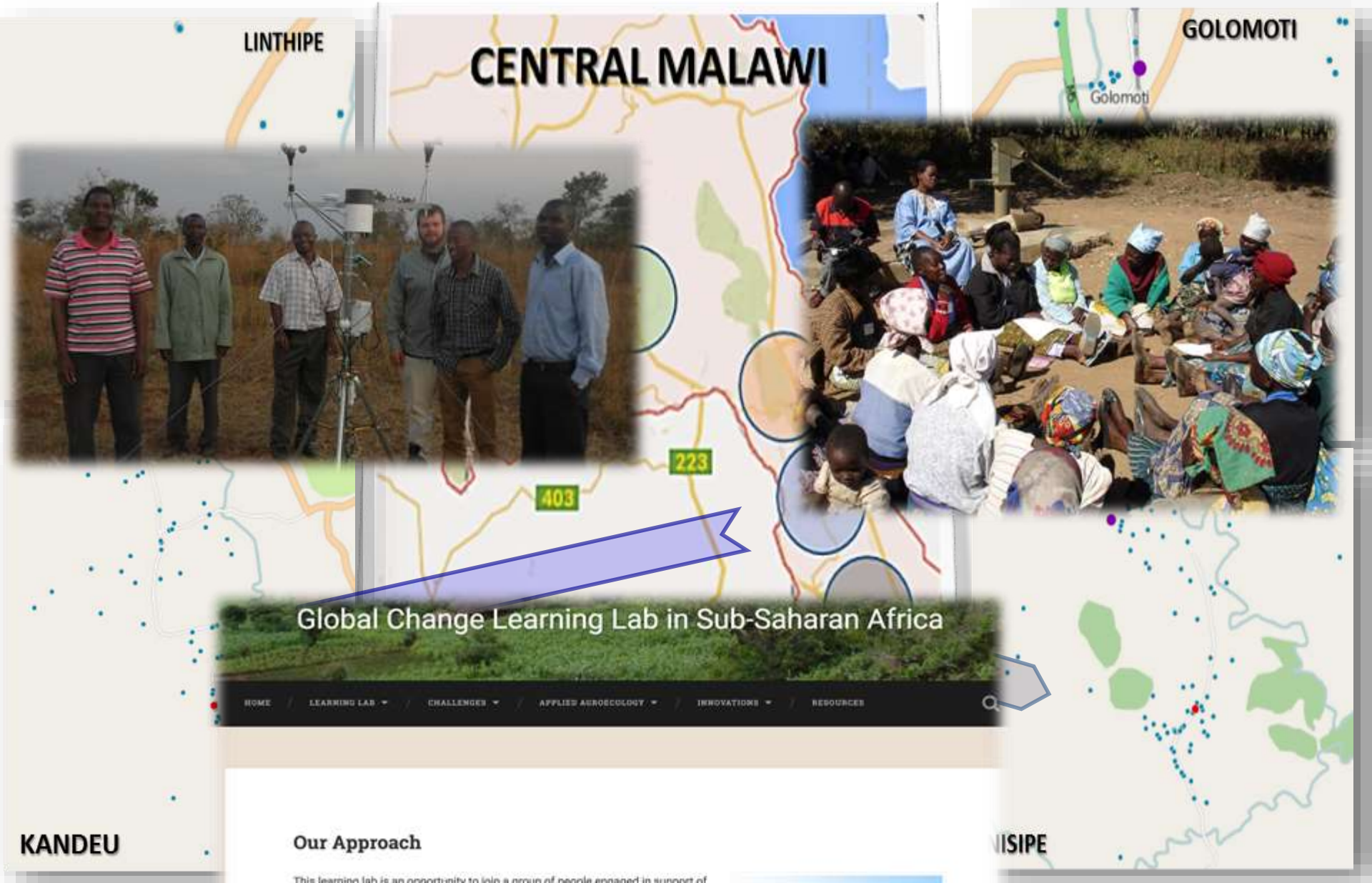
Best bet options: work in progress!

- Permanent ridge tillage
- Tied ridges & basins
- Point application of ferti
- Seed-treatments: rhizob

Priority #3

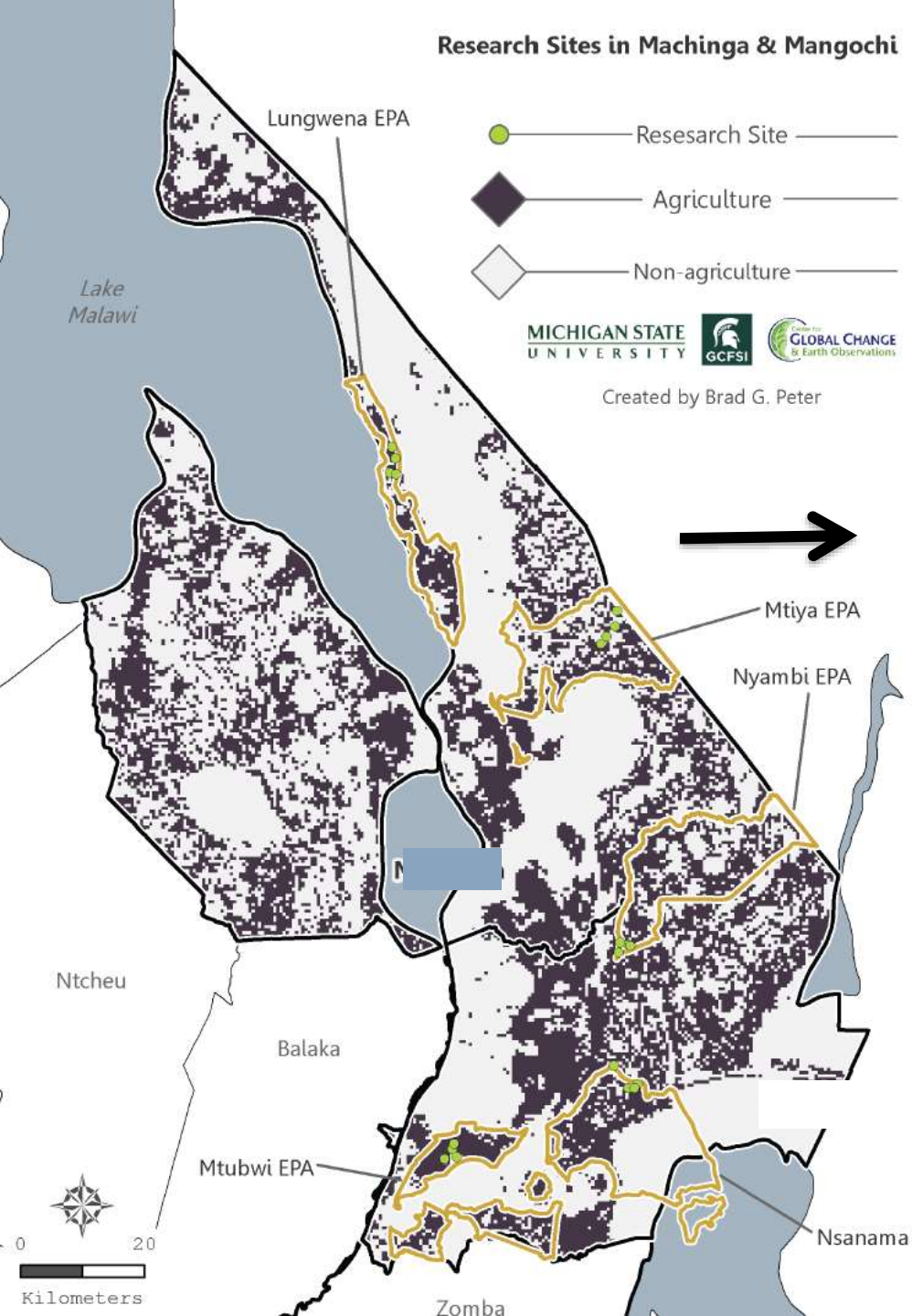
Participatory action research

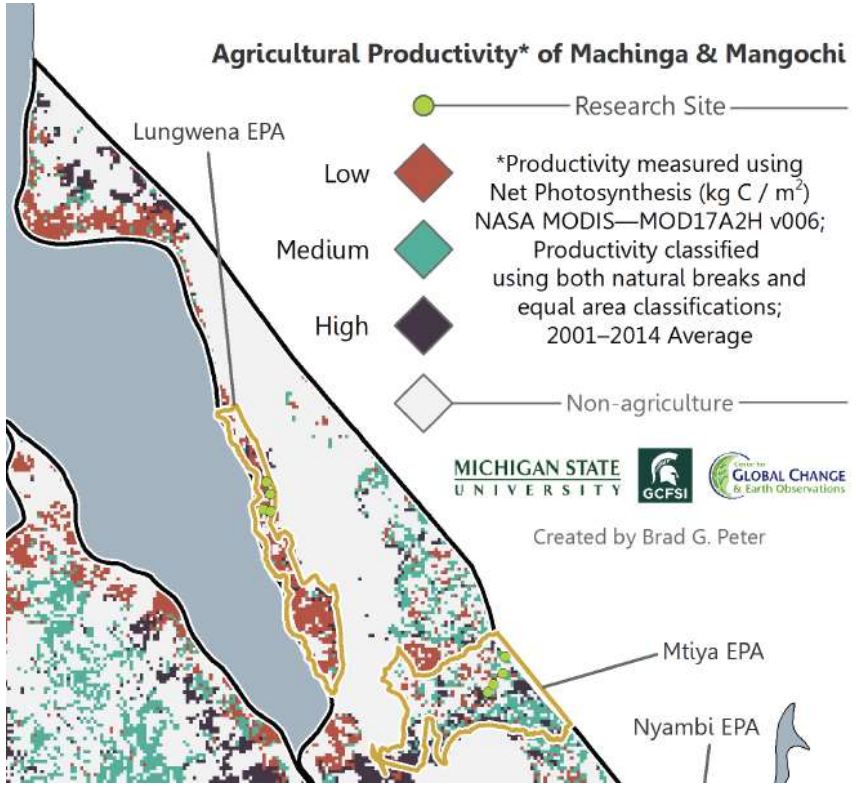
Africa RISING – Participatory action research



- **Baseline characterization** stratified random choice of four sites from low potential, risky (Lakeshore, Golomoti) to high potential (Upland plain, Linthipe)
- **Established** participatory action research: 8 mother trials and 400 baby trials
- **Innovation platforms** with Malawi extension, NGOs, other stakeholders

2012/13 Africa RISING Malawi





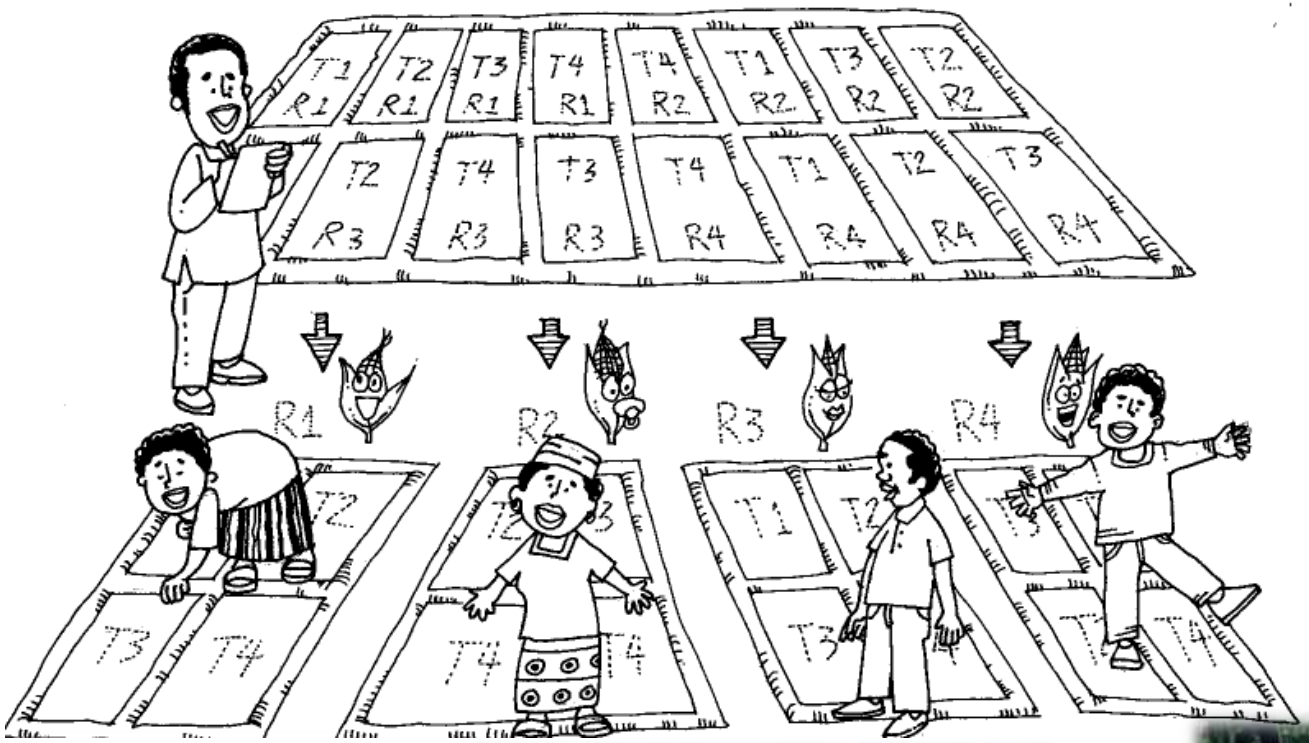
Africa RISING expansion
2016-17
65 mother trials
2000 baby trials

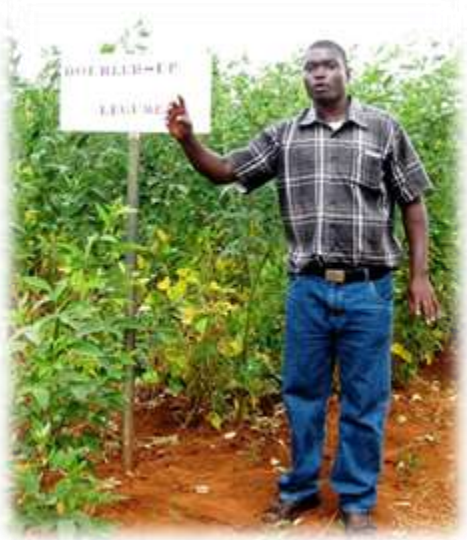
Participatory action research

Design

REFLECT → PLAN → Better bet options → ACT: Test best bets → Mother & Baby Trials, Modeling → Capacity

Mother and baby trial design: Plan, Act, Reflect





Mother and her babies

TECHNOLOGY OPTIONS

2 year Rotation

Year 1

Year 2

Technologies

- **Maize**
- Cowpea
- Groundnut
- Pigeon pea
- Soy
- Bean + Groundnut
- Pigeonpea + Groundnut
- Pigeonpea + Soy
- Cowpea + Groundnut
- Maize + Pigeonpea
- Maize + Cowpea
- Maize + Bean
- Cowpea + Groundnut + Soy

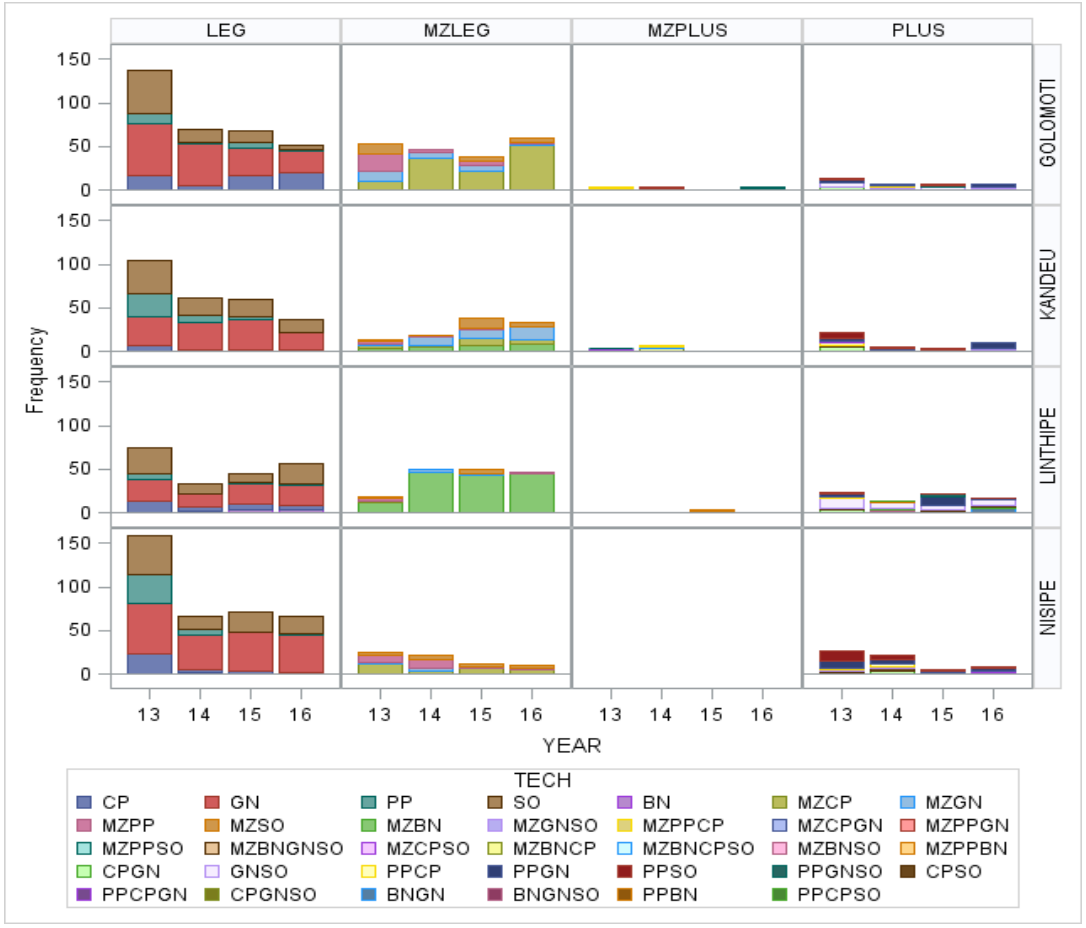
Systems

- Sole cropping
- Doubled up legumes
- Intercrops
- Triple Legume *Farmer innovation*

Technologies

- Maize
- Maize
- Maize
- Maize
- Maize
- Maize + Ratooned P'pea
- Maize
- Maize
- Maize + Ratooned P'pea
- Maize + P'pea
- Maize
- Maize

Baby trials: EXPERIMENTATION



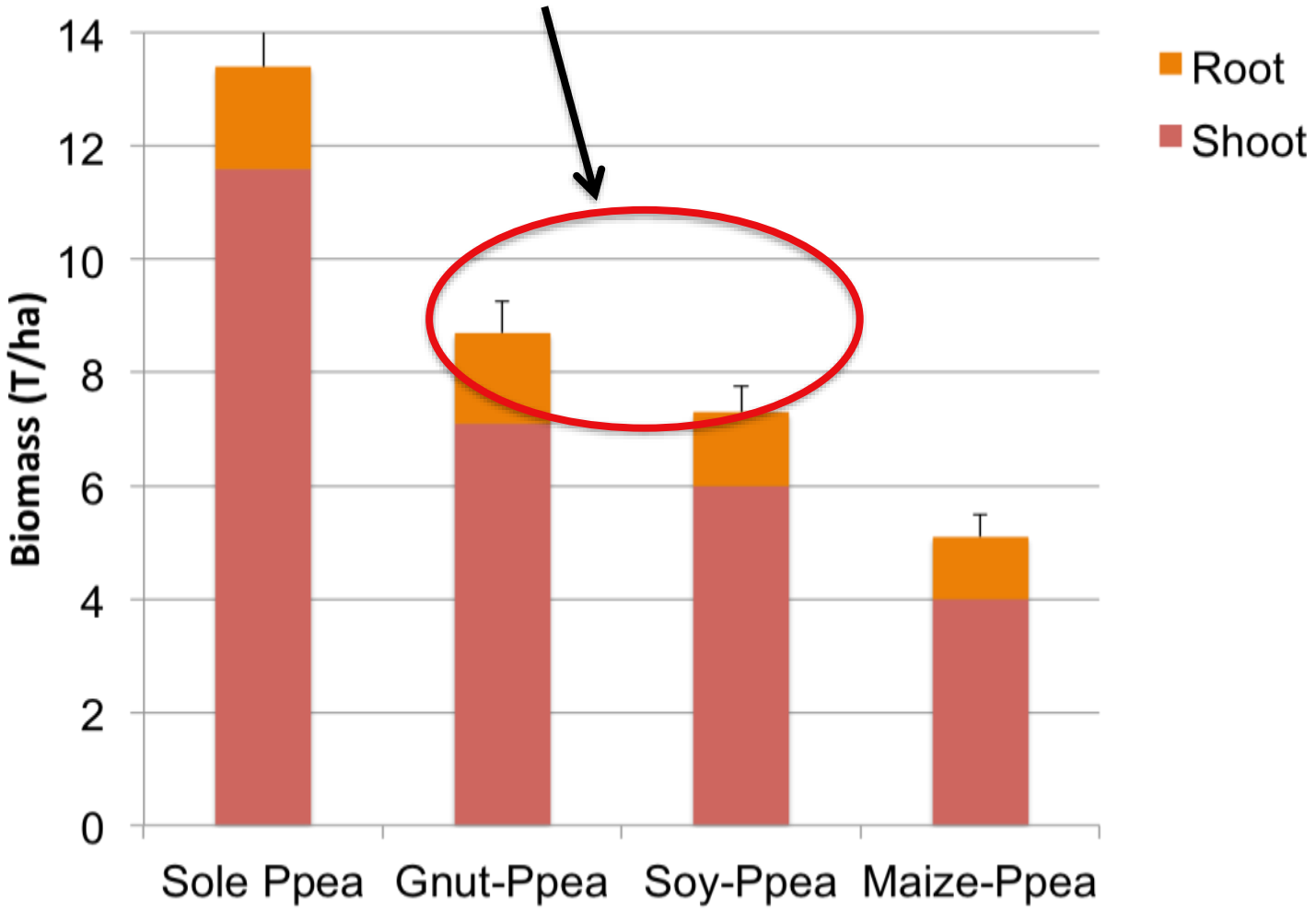
Anders et al. unpublished, n= 960

0- 20 cm

20- 40 cm

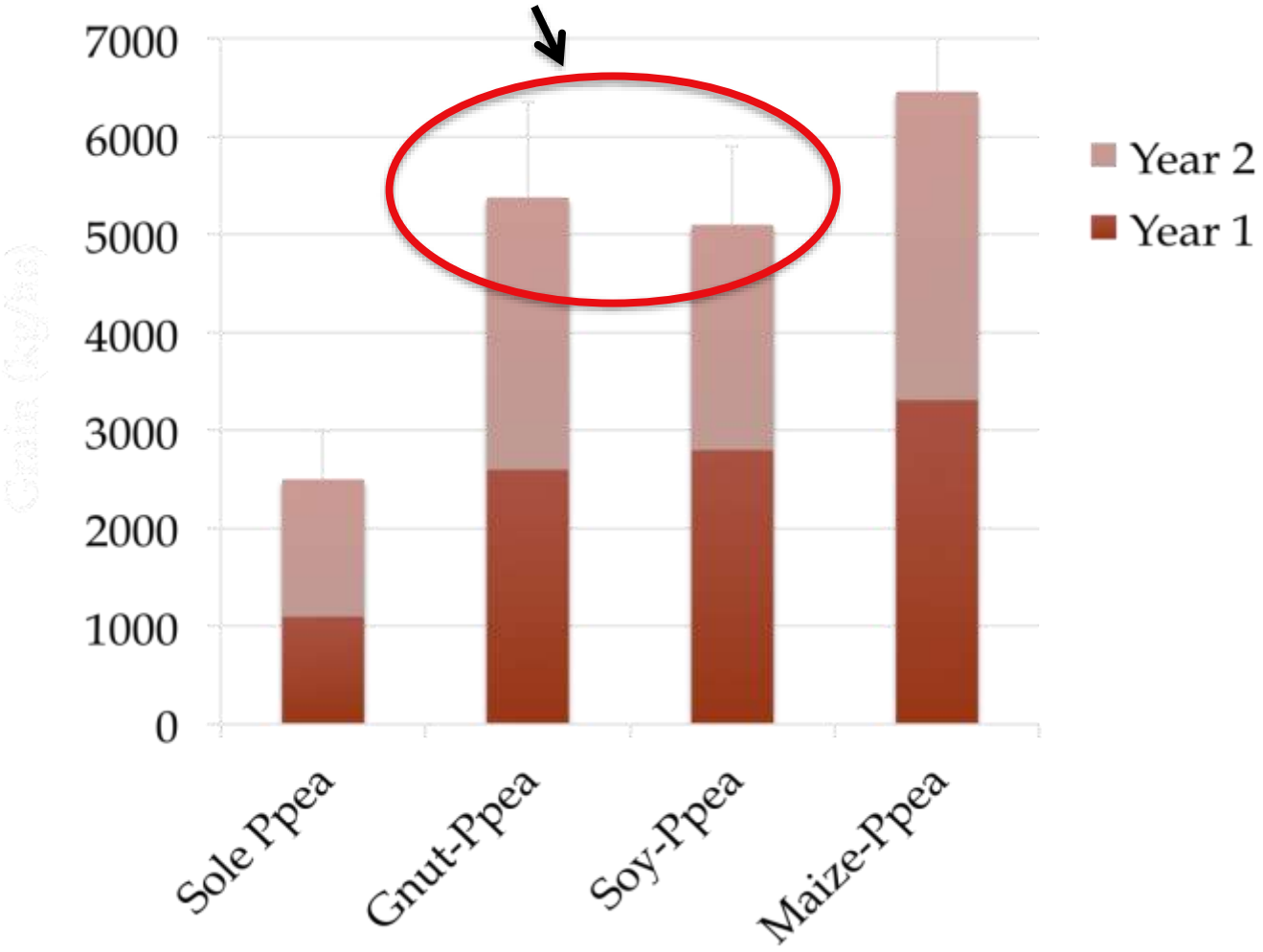
40- 60 cm

Mother trials: BIOMASS data



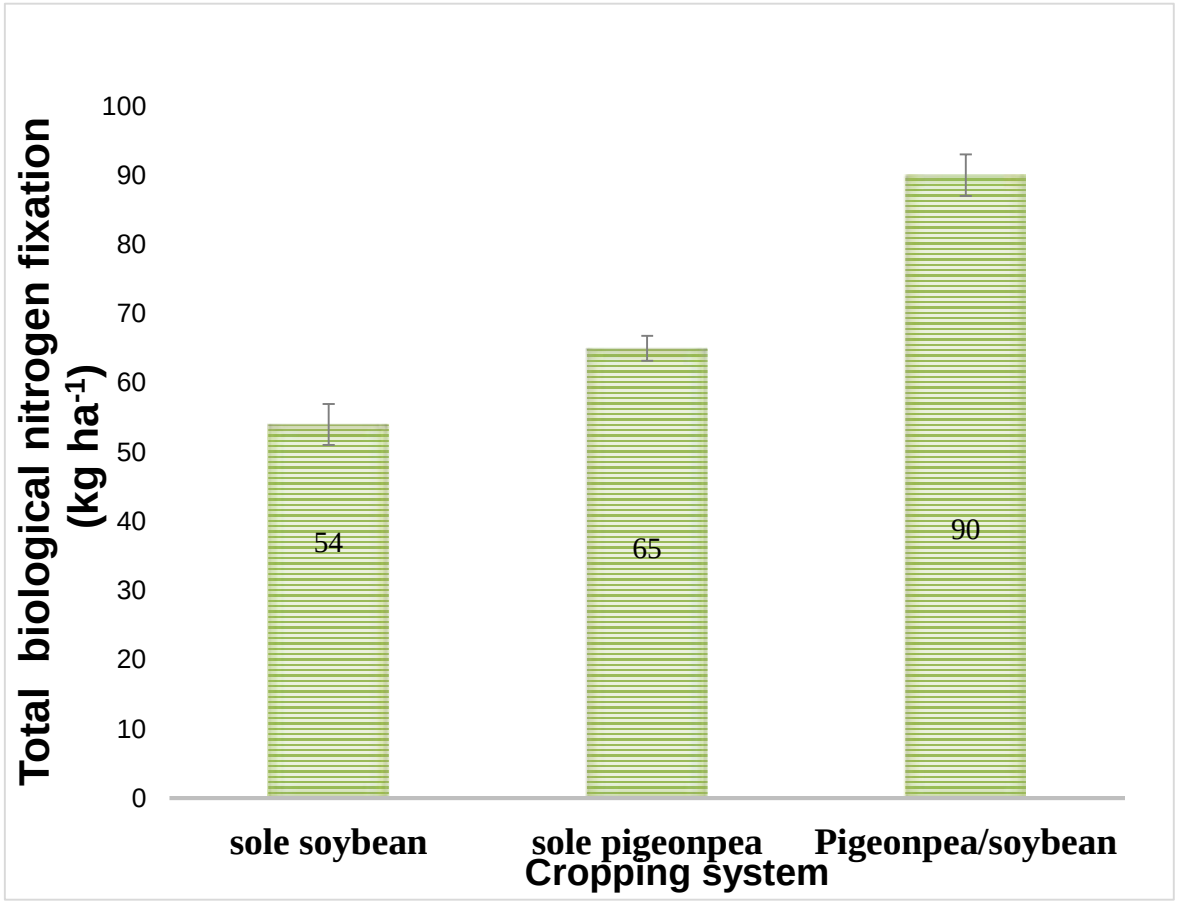
C. Gwimbera et al. submitted (n=24)

Mother trials: GRAIN data



C. Gwimbera et al. submitted (n=24)

Mother and baby trials: **Capture more nitrogen & phosphorus**



- Land equivalent ratio = 1.44
- N accrured under intercrops 67 and 38.5 % higher than sole soybean and pigeonpea, respectively

E. Mzumara and W. Mhango, 2016

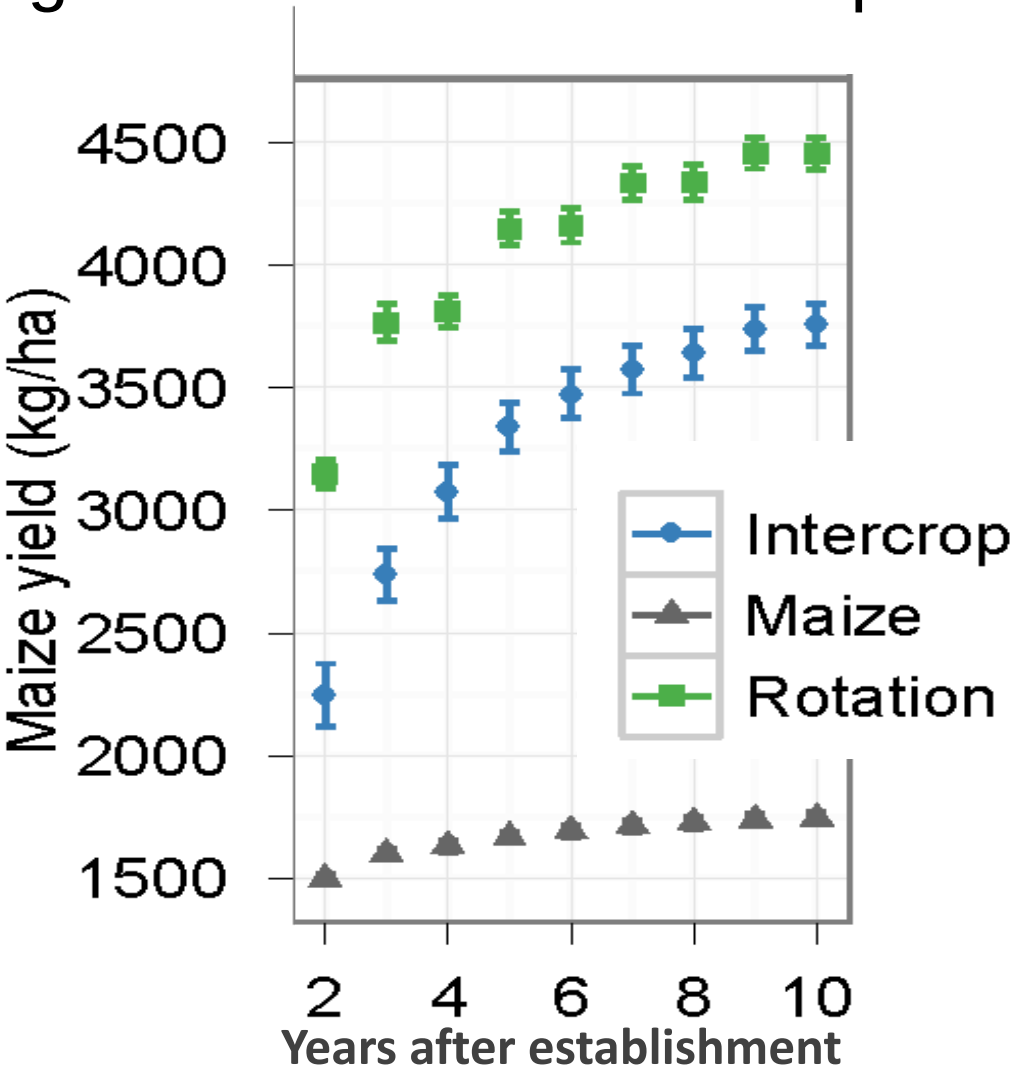
Capture more nitrogen & phosphorus

Soil fraction	Total Nitrogen (mg N/kg)		Organic Phosphorus (mg P/kg)	
	Maize	Pigeonpea	Maize	Pigeonpea
Bulk Soil	1734	1686	90	82
Aggregates				
Macro	1405	1524	84a	98b
Micro	974a	1323b	29a	77b
Silt+Clay	2102	2056	157	134

G. Garland, J. Six et al, 2017

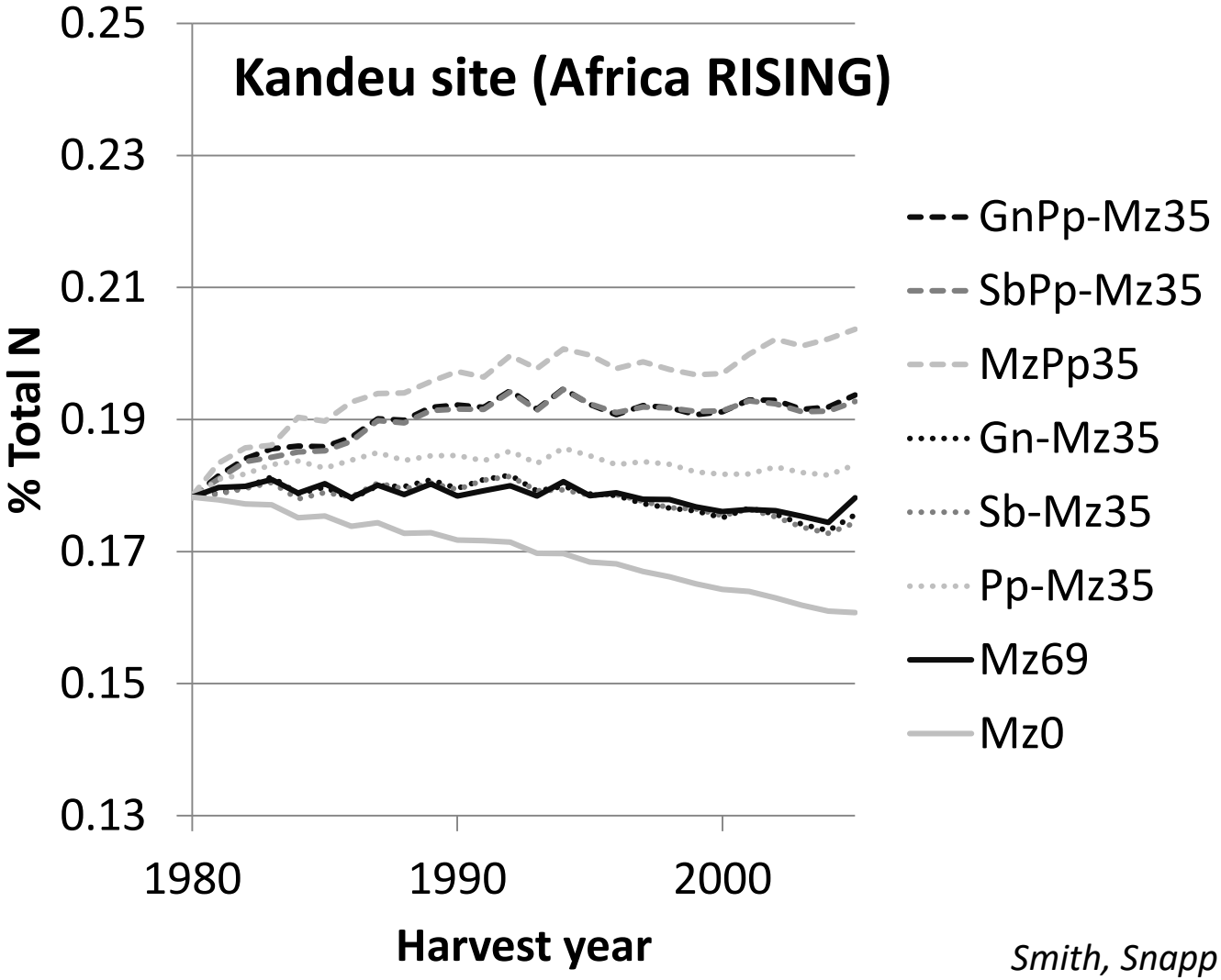
APSIM: Doubled-up legume rotation vs intercrop

Resilient legumes = more biomass = resilient soils = higher, more **reliable** yields



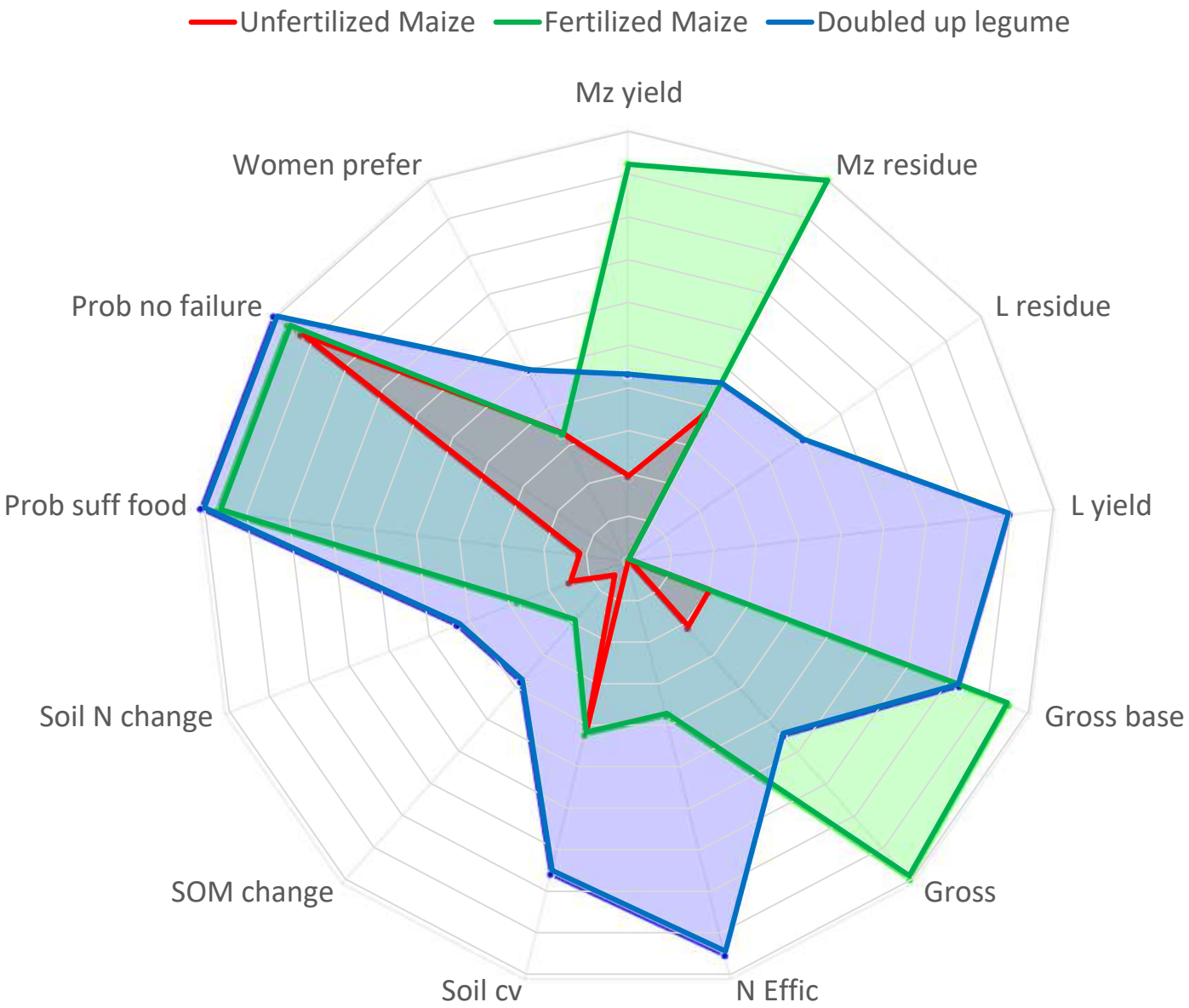
Ollenburger and Snapp, 2015

APSIM: Soil N status over time



Smith, Snapp et al., 2016

Sustainable Intensification Indicators: Linthipe AR site



Summary

Resilient legume systems

- Better bet options: pigeonpea, lablab, double row legumes, and doubled up legume rotation

Zonal management

- Work in progress: seed treatments, ridge alignment, others under testing

Summary: Legume better bet options

- Double row soybean, groundnut (**market linked farmers**)

- Doubled up legumes (**resource poor farmers on marginal lands**): Released by Malawi government March, 2016

Next steps

- **Scaling:** Extension approaches and seed systems
- **Food systems:** collaboration with nutritionists, gender scientists
- **Multipurpose systems:** fuel, fodder for crop-livestock integrations
- **Zonal management better bet options:** developing through participatory action research

Production of soyabean flour for nutritious soya porridge (mixture of soya, groundnut and maize)






Diversity of legume products

http://soilandfood.org/

MAFFA, Ekwendeni Malawi

Global Change Learning Lab in Sub-Saharan Africa

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Our Approach

This learning lab is an opportunity to join a group of people engaged in support of science without borders, with a focus on agroecology in sub-Saharan Africa. The challenges are tremendous, including resource degradation, inequitable access to resources, population pressure and changes in effective demand for food. We are committed to a "community of practice" approach, interacting and learning from

What learning lab do you want to start?