Building Soil Health for Smallholder Resilience

Speakers

Geoffrey Heinrich, *Catholic Relief Services*

Sieglinde Snapp, *Michigan State University*

Jerry Glover, *USAID Bureau for Food Security*

Facilitator

Julie MacCartee, *USAID Bureau for Food Security*

December 10, 2015

Jerry Glover

Jerry Glover is a National Geographic Society Explorer and Senior Sustainable Agricultural Systems Advisor for USAID. He earned bachelor degrees in soil science and philosophy and then a PhD in soil science at Washington State University in 2001. Prior to his work at USAID, Glover studied native grasslands and farming systems, including no-till, perennial, organic and integrated systems. He has published the results of his work in Science, Nature, Proceedings of the National Academy of Sciences and Scientific American. His work in soil science and perennial-based farming systems has been highlighted in National Geographic, Nature, and three documentary films. Most recently, Scientific American included Glover's work in its December 2011 special issue on the "Top Ten World Changing Ideas."

Productivity decline and degradation "hotspots" in Africa

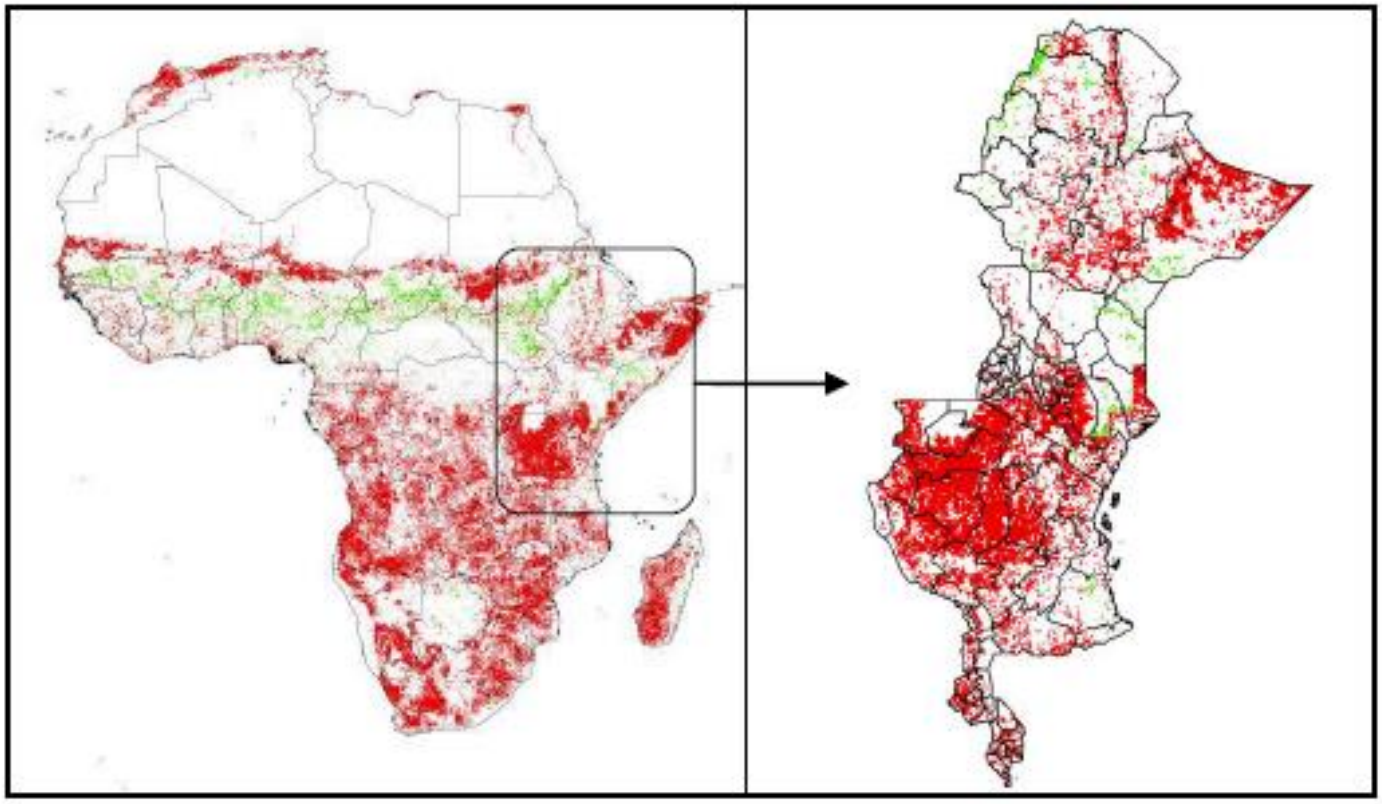


Figure 1: Biomass productivity decline in Eastern Africa over 1982-2006.
Source: Adapted from Le, Nkonya & Mirzabaev (2014).

Source: Kirui, O. and Mirzabaev, A. (2015). Drivers of land degradation and adoption of multiple sustainable land management practices in Eastern Africa.

Geoffrey Heinrich

Dr. Geoff Heinrich is a Senior Technical Advisor for Agriculture, Environment and Rural Livelihoods for CRS. Throughout his 25 years in on-farm research and development, Geoff has helped smallholder farmers in Africa and Asia to increase farm productivity and food security, as well as protect the environment through sustainable resource use. Geoff has served in both scientific and management positions with agriculture research institutions and holds a PhD in Crop and Soil Science.

Sieglinde Snapp

Dr. Sieg Snapp is a Soils and Cropping Systems Ecologist at Michigan State University and Associate Director of the Center for Global Change and Earth Observations. She has edited two books and published more than 100 journal articles and extension bulletins on sustainable intensification, agricultural systems, and participatory action research. Her research interests include international agricultural system design for a changing climate and understanding factors driving soil processes in tropical Africa. She has pioneered improved soil management, including multipurpose crops with integrated nutrient management. Dr. Snapp is possibly best known for being the ‘mother’ of the mother and baby trial design, as a means to support participatory research, communication and innovation.

CATHOLIC RELIEF SERVICES

Restoring Soil Health for Smallholder Resilience in Africa:

Critical Issues and Options

Geoff Heinrich

Agrilinks Webinar

December 2012

faith. action. results.

The critical nature of soil, and the impacts of loss…

Humankind, despite its artistic pretensions, its sophistication, and its many accomplishments, owes its existence to a six-inch layer of topsoil and the fact that it rains. (Anonymous)

The critical nature of soil, and the impacts of loss…

"…and rainfall runoff takes away about 40 percent of the nutrients applied to the soil [in Africa] through organic and mineral sources of fertilizer[107]." (1)

The critical nature of soil, and the impacts of loss…

"In Africa, the most conspicuous symptoms of the negative impacts of land degradation on food production are *stagnating and declining yields and increasing levels of poverty*"
(FAO)

Some additional data and quotes (4):

In Africa, areas already damaged:

- **65% (+) of arable land**
- **30% of grazing land**
- **20% of forests**

Africa imports US$ 40 billion worth of food annually [already] …

Soil is the cornerstone of food security… and its conservation should become a major global priority

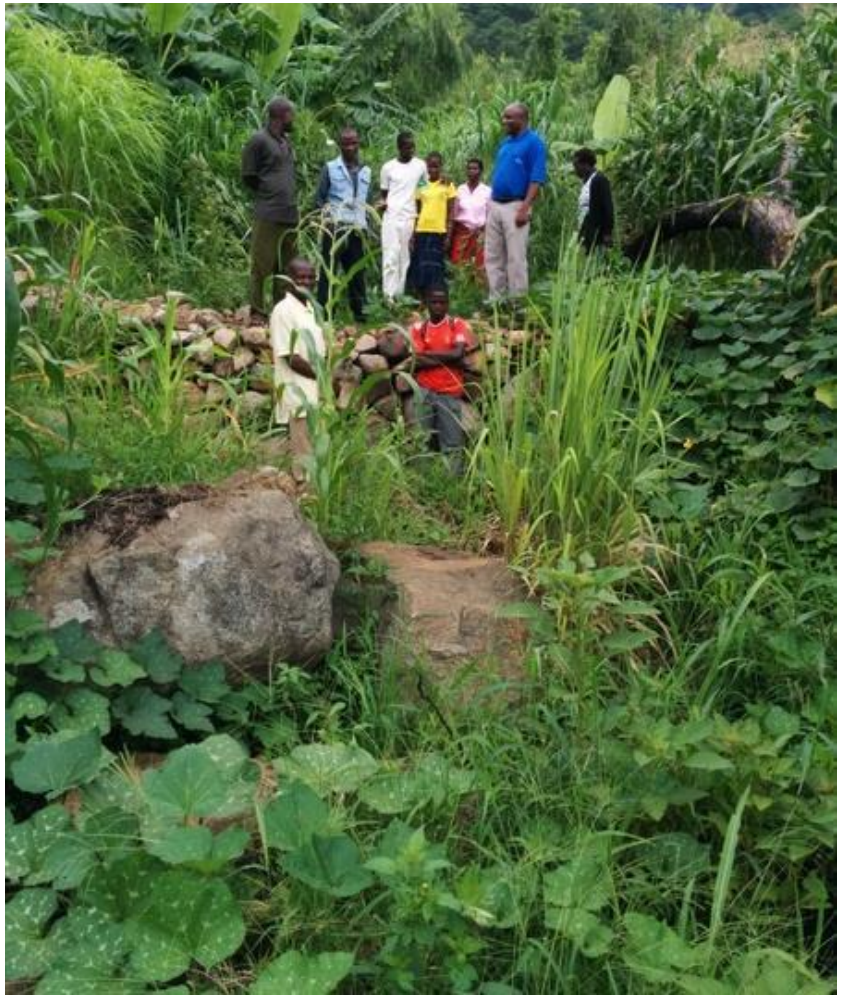
There is a crisis of land degradation and soil management..

The Good News: We can reverse the soil degradation process and restore productivity with known technology (*quickly*)

Need to work at both the *Landscape* and *farm* levels.

Landscape Level work is vital:

- **Many ecosystem services depend of L'scape-level work**
- **E.g., Water (Malawi FFP WALA)**
  - **Increase stream flows**
  - **Raise water table (wells)**
  - **Increase crop yields, even in dry years**



Some good Landscape - level interventions:

- Community-based NRM
- Watershed Management (a la Malawi, Ethiopia)
- Farmer Managed Natural Regeneration (five mill ha. in Sahel)
- Don’t burn, don’t deforest…

Key Issues - Farm-level soil regeneration:

Farmers have serious constraints. New technologies must:

- Not cost any extra money or labor
- Not have any "opportunity costs"
- Have immediate benefits (food or income) *plus* long-term bene's.
- Must be "feasible" / "accessible"

Most gov'ts still promoting sole maize/commercial fert.

- Some also promoting C.A. but
  - Farmers only use part of the pkg. (no rotations, little mulch)
  - Less impact and slow adoption
  - CA by itself, is not enough

Right policies and incentives must be in place to promote regenerative forms of agriculture

Farm-level soil regeneration:

Rebuilding soil O.M. essential:

- Increase water-holding capacity
- Increase nutrients / availability
- Increase Fertilizer Use Efficiency
- Increase soil health, productivity

Green Manure/Cover Crops:

- The best option
- “Intercrops” not rotations
- Accompanied by minimum tillage
- CRS working with Roland Bunch on these options

The Seeds Issue:

Increasing soil OM and N avail:

- **Intercropping with legumes or tree species (gm/cc) or**
- **Legume rotations/fallows**

The commercial seed sector:

- **No interest in food legumes and/or tree species**

Move to support

- **Niche/small seed companies**
- **Farmer-based seed systems?**
- **Louise Sperling - new initiatives**

Summary and Conclusions:

Crucial to invest in restoring the soil

- Both *farm* and *landscape* levels
- Soil organic matter is key
- *Soil health improves all else*

Priority for Govts, donors, pvt sector*

- As well as farmers
- Need right policies, incentives
- Have to address the seed issue

There is much that can be done

- Rapid impacts are possible

New technologies must address farmers *real constraints* and *needs*

Building Soil Health for Smallholder Resilience

S. Snapp, R. Chikowo, E. Anders, M. Bekunda, C. Gwenambira, I. Hoeschle-Zeledon, T. Jayne, J. Messina and A. Smith

Challenges

Degraded soil

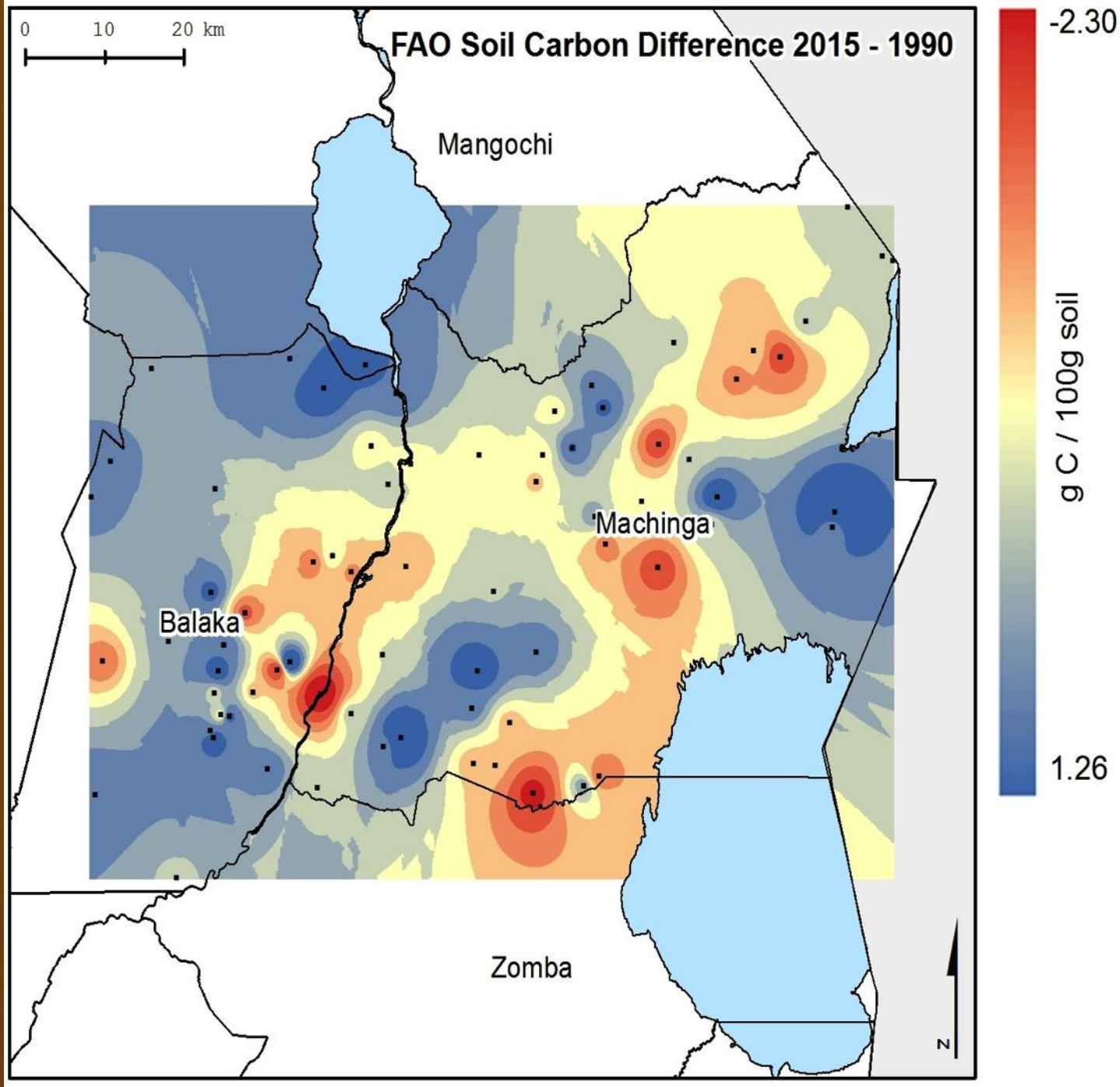
Food insecurity

Environmental insecurity

Degraded soils

Drivers of degradation

Malawi soil carbon



Placid Mpeketula
PhD Dissertation

Legume growth types

Annuals - for food

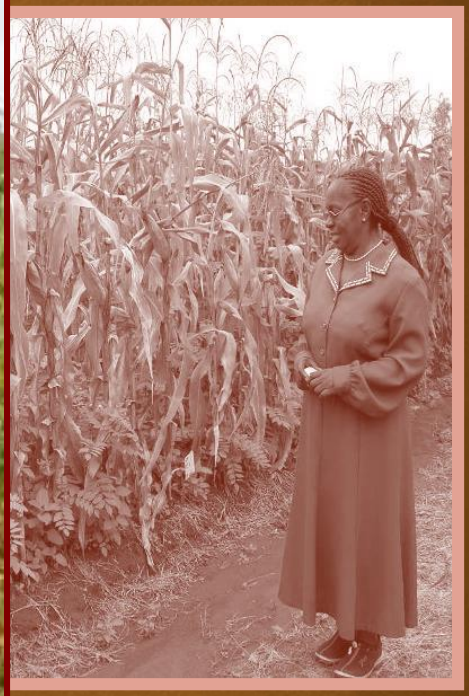
Low-nutrient

Perennials - for soil fertility & fuelwood

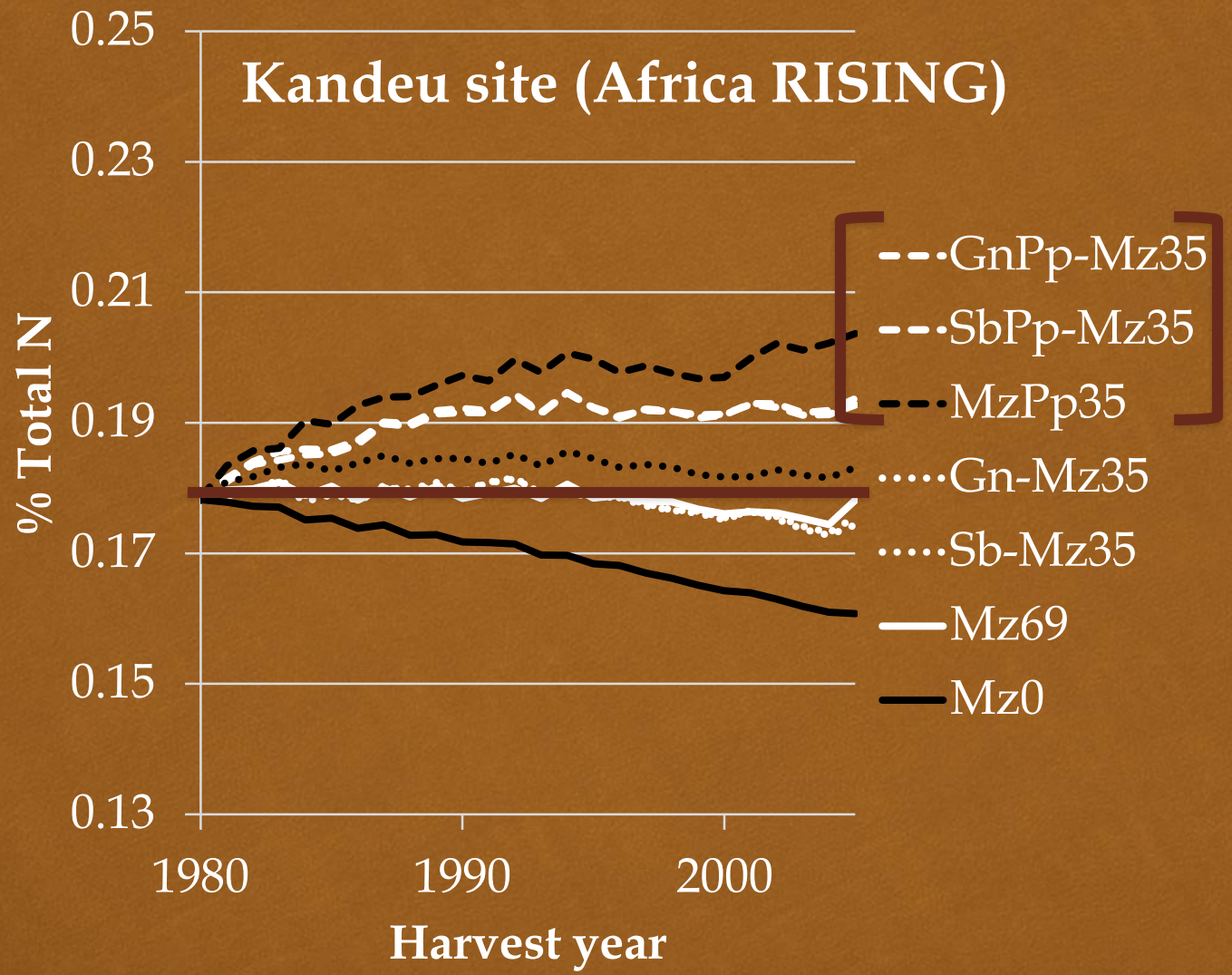
High-nutrient

Legume growth types

Shrubby pigeonpea - multipurpose



APSIM model: Soil N status over time



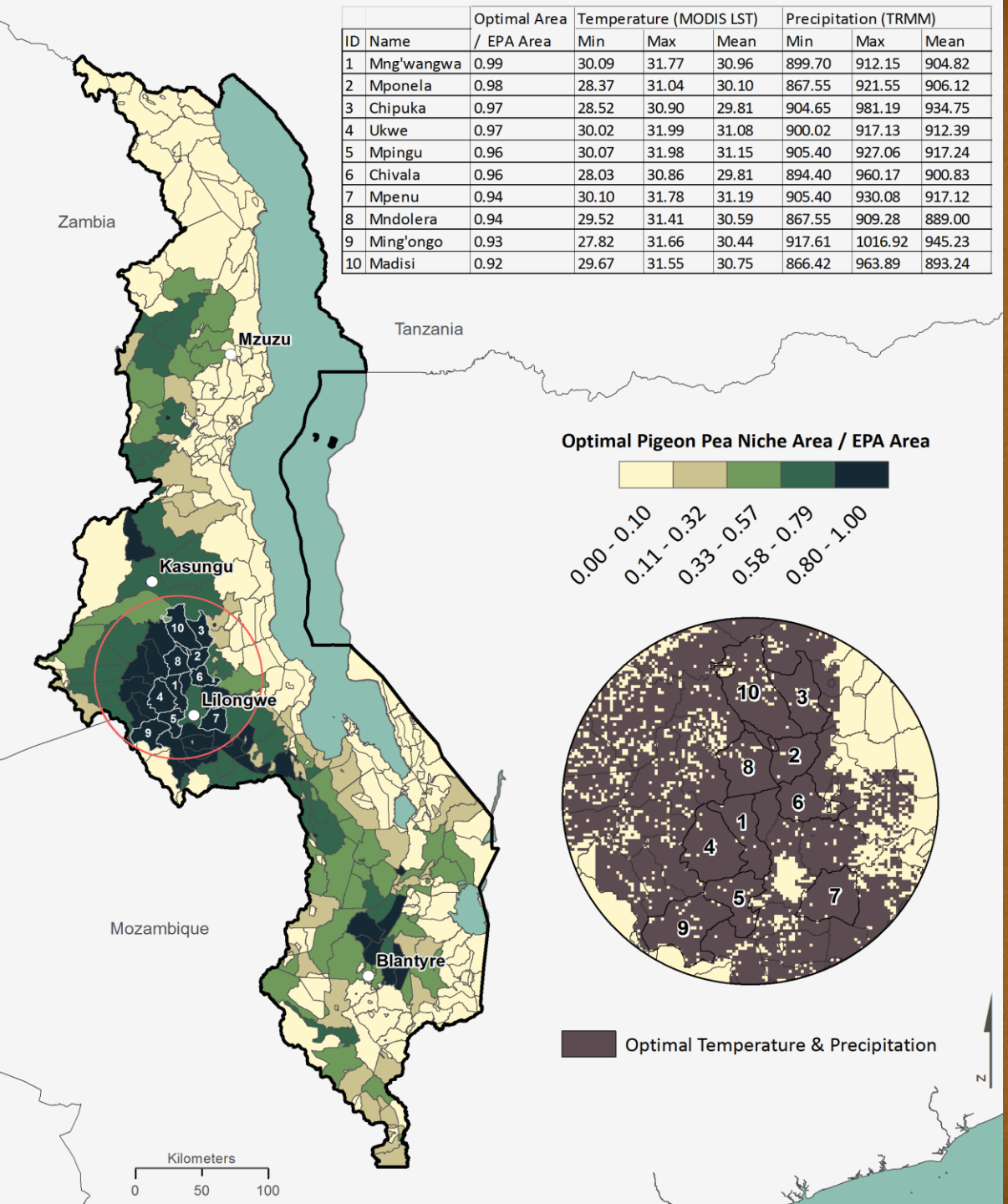
Smith and Snapp, unpublished

Pigeonpea shrub + Maize

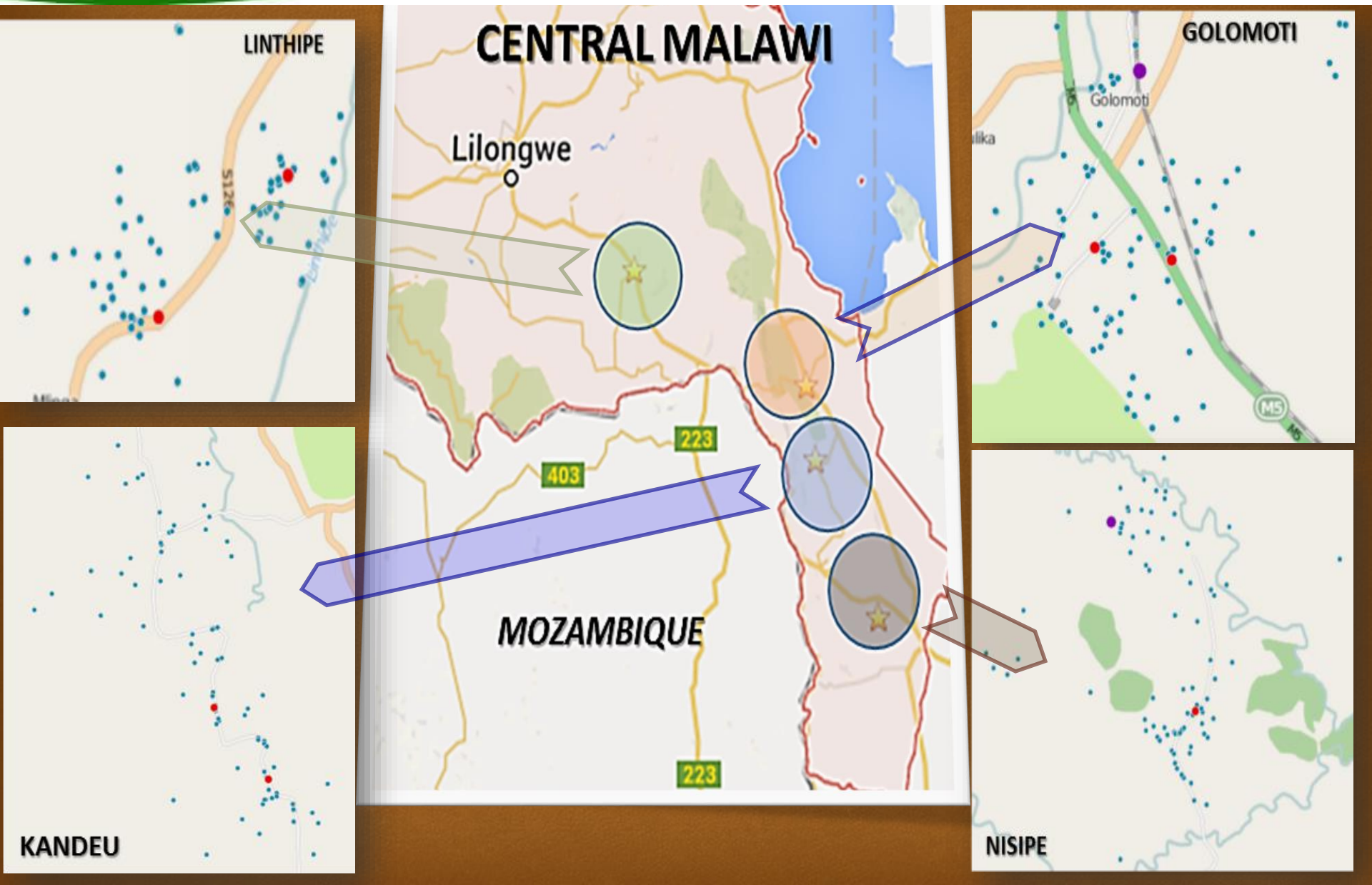
Pigeonpea shrub + Groundnut understory

Pigeonpea: Malawi niche

ID	Name	Optimal Area / EPA Area	Temperature (MODIS LST) Min	Max	Mean	Precipitation (TRMM) Min	Max	Mean
1	Mng'wangwa	0.99	30.09	31.77	30.96	899.70	912.15	904.82
2	Mponela	0.98	28.37	31.04	30.10	867.55	921.55	906.12
3	Chipuka	0.97	28.52	30.90	29.81	904.65	981.19	934.75
4	Ukwe	0.97	30.02	31.99	31.08	900.02	917.13	912.39
5	Mpingu	0.96	30.07	31.98	31.15	905.40	927.06	917.24
6	Chivala	0.96	28.03	30.86	29.81	894.40	960.17	900.83
7	Mpenu	0.94	30.10	31.78	31.19	905.40	930.08	917.12
8	Mndolera	0.94	29.52	31.41	30.59	867.55	909.28	889.00
9	Ming'ongo	0.93	27.82	31.66	30.44	917.61	1016.92	945.23
10	Madisi	0.92	29.67	31.55	30.75	866.42	963.89	893.24

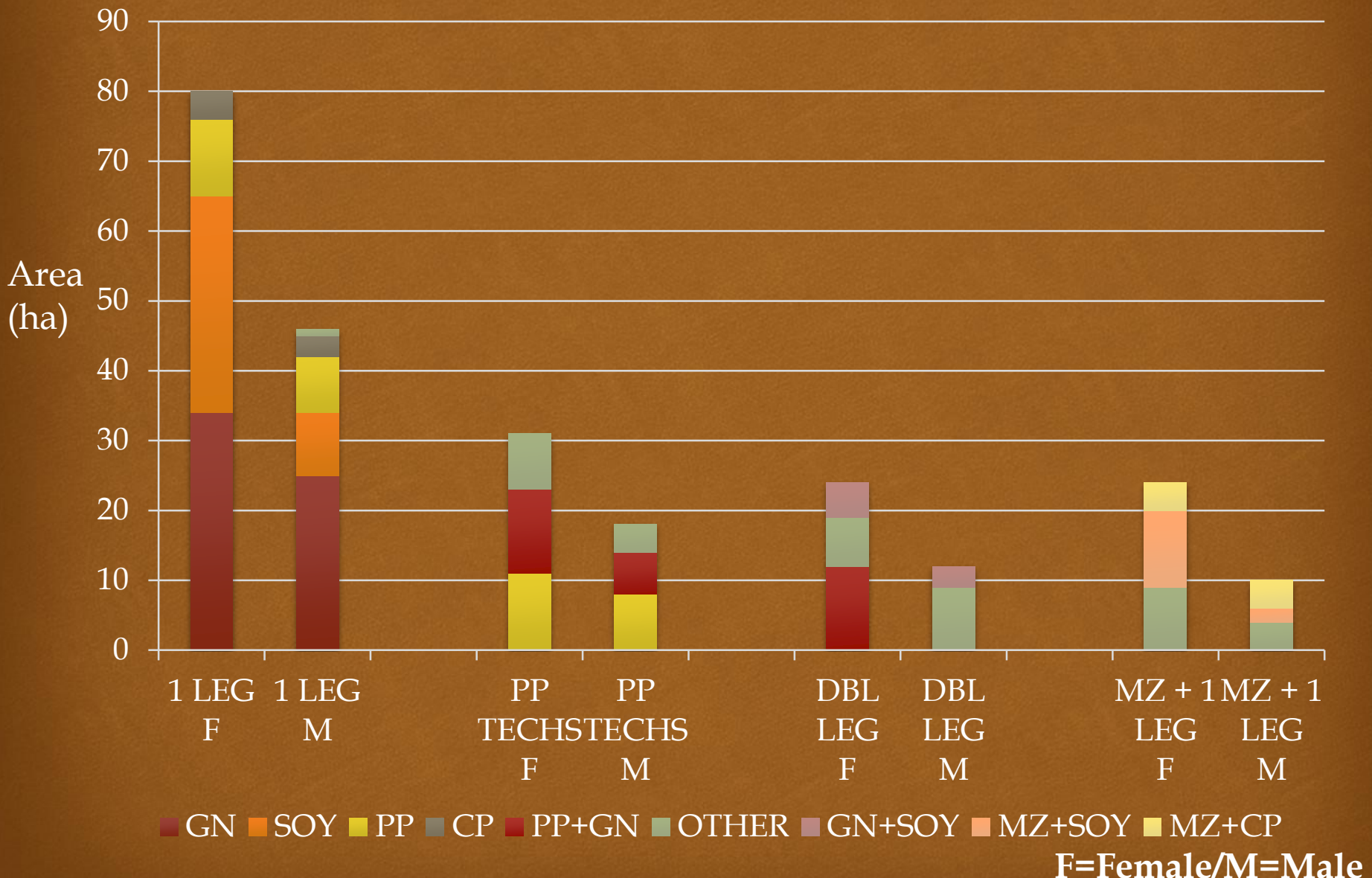


Messina, Peters, et al. unpublished data


LINTHIPE
CENTRAL MALAWI
Lilongwe
GOLOMOTI
Golomoti
223
403
MOZAMBIQUE
223
KANDEU
NISIPE

Pigeonpea on-farm experimentation

Innovation: Technologies expanded in year two



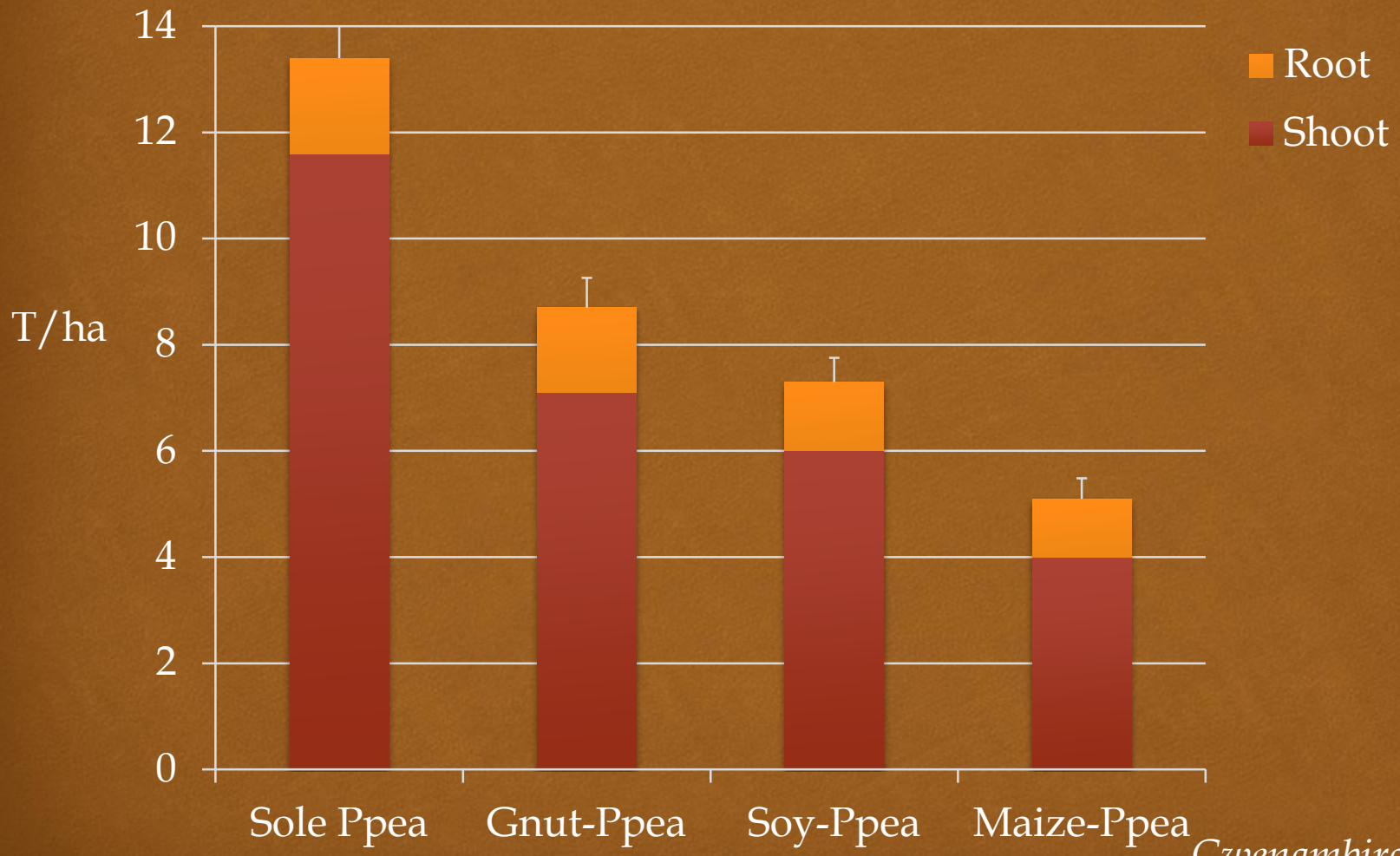
F=Female/M=Male

Quantifying biomass produced by multipurpose legumes on-farm

0- 20 cm

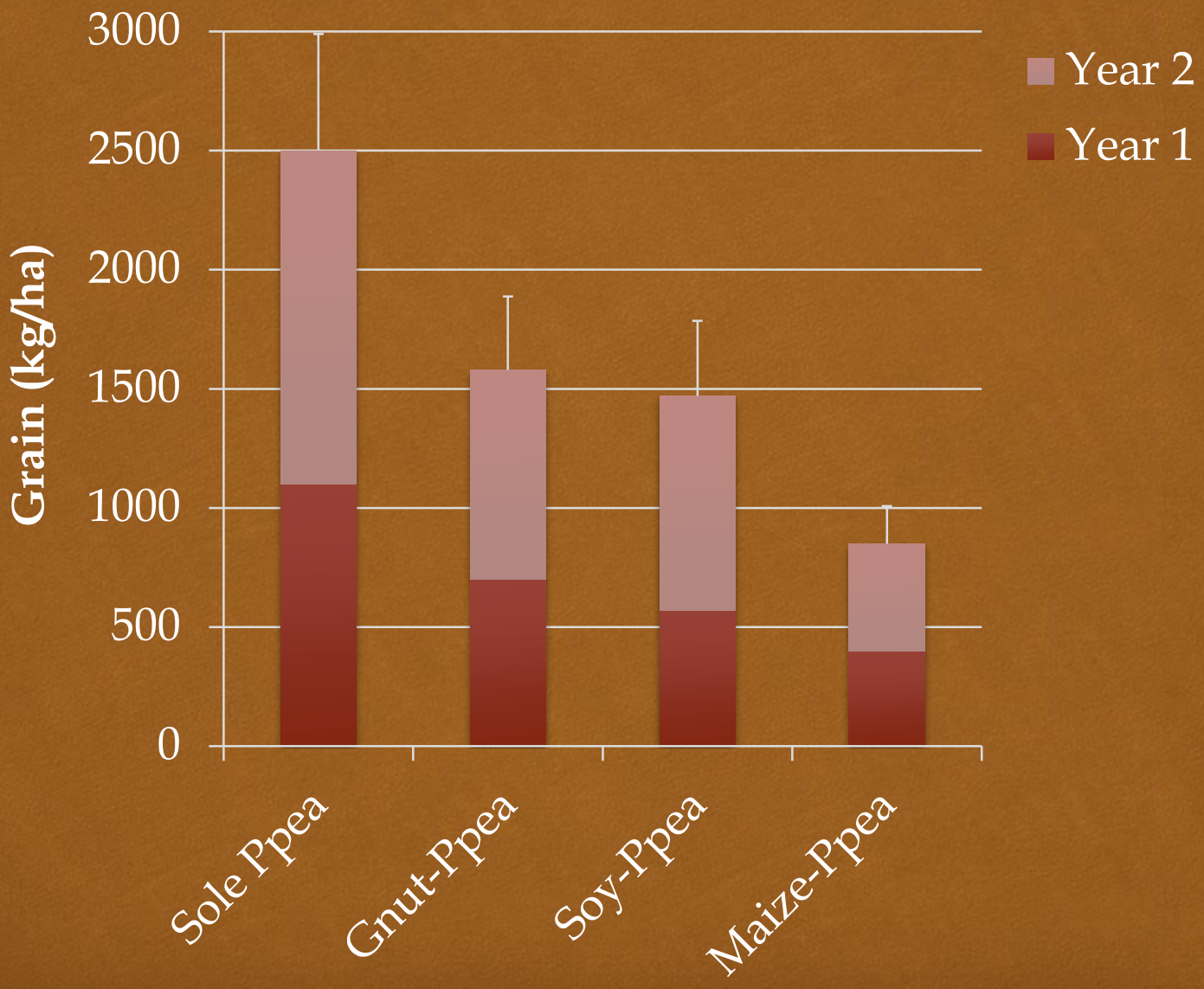
40- 60 cm

Pigeonpea biomass

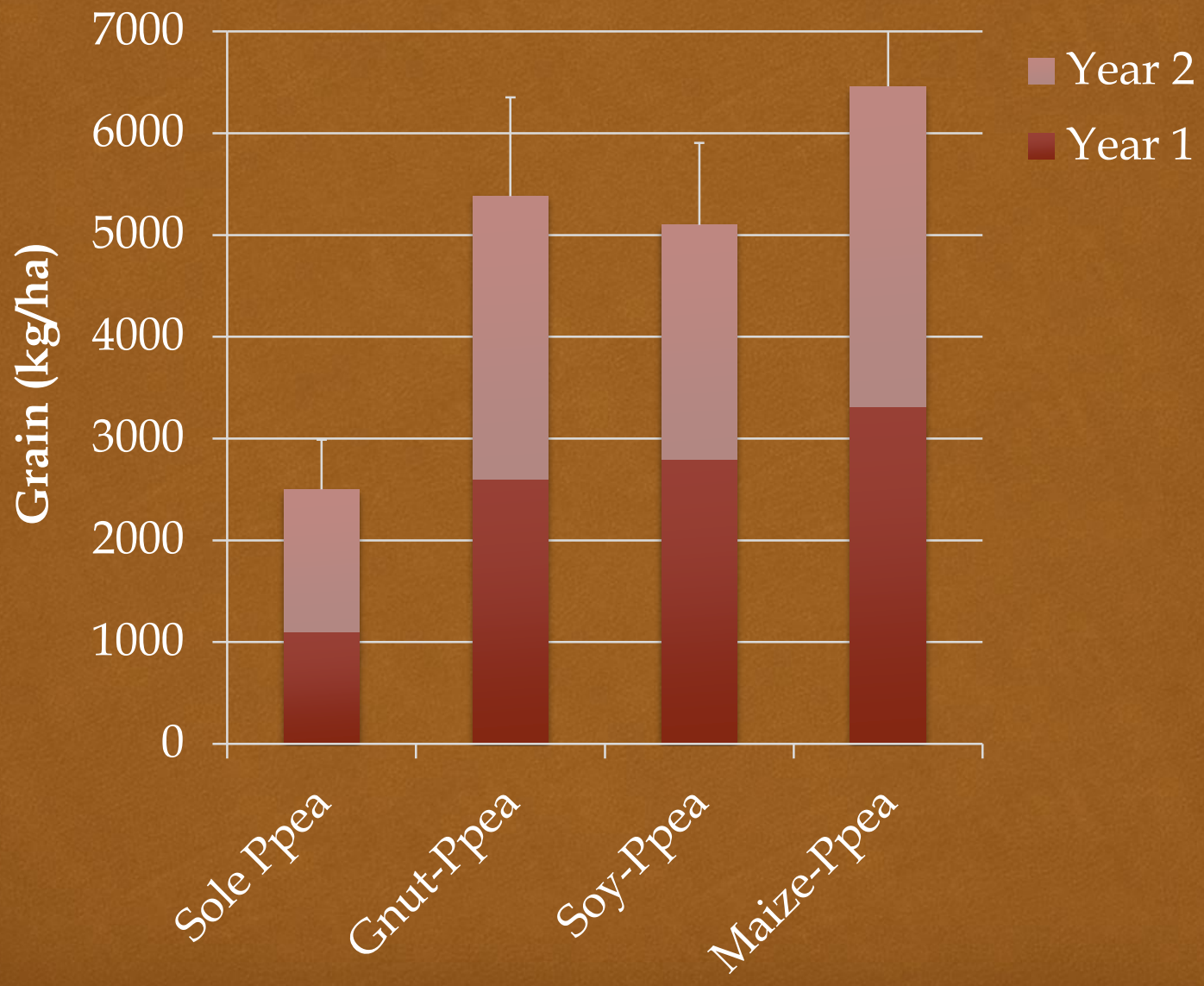


Gwenambira et al 2015

Pigeonpea grain yield

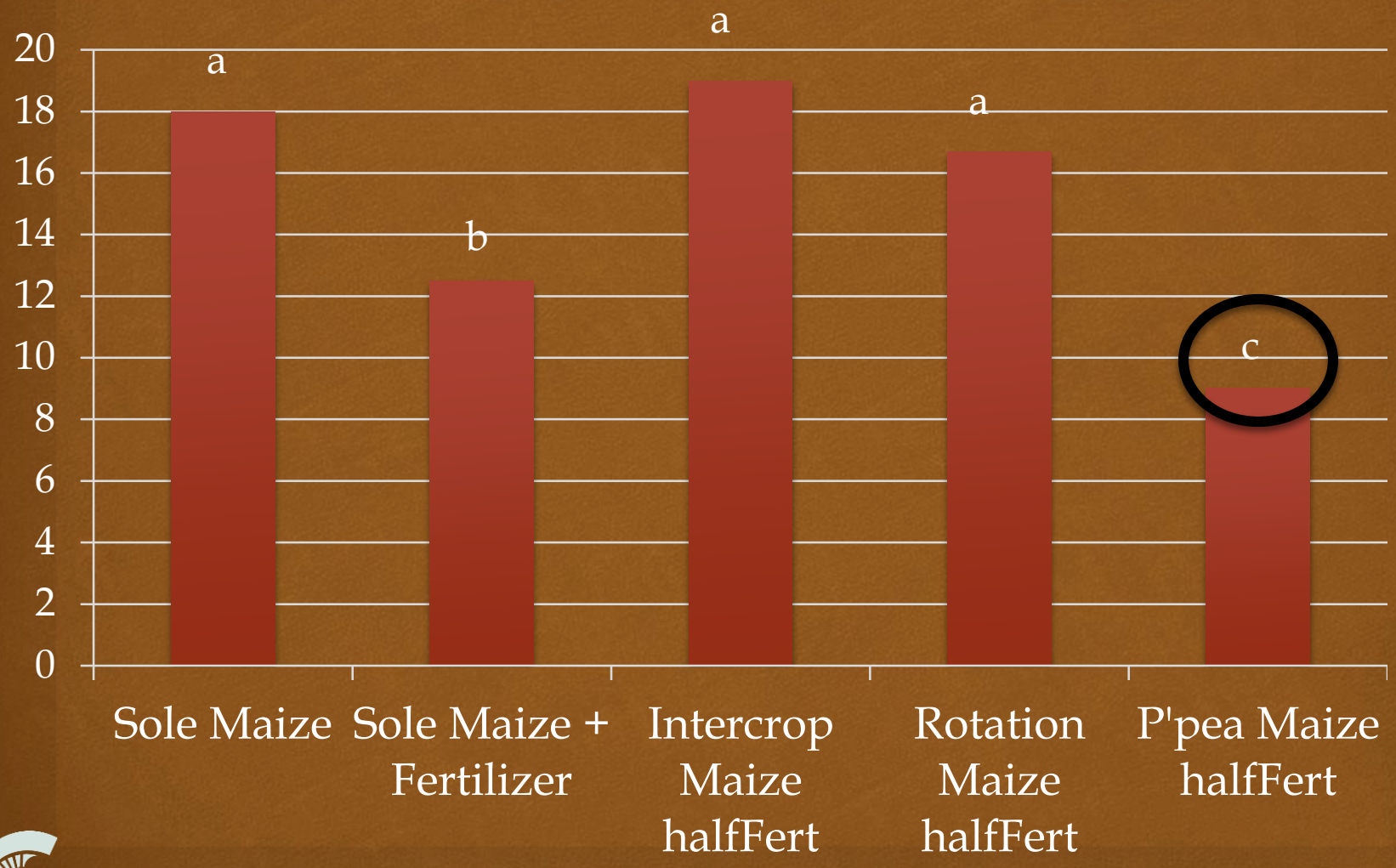


Two year rotation: grain yield



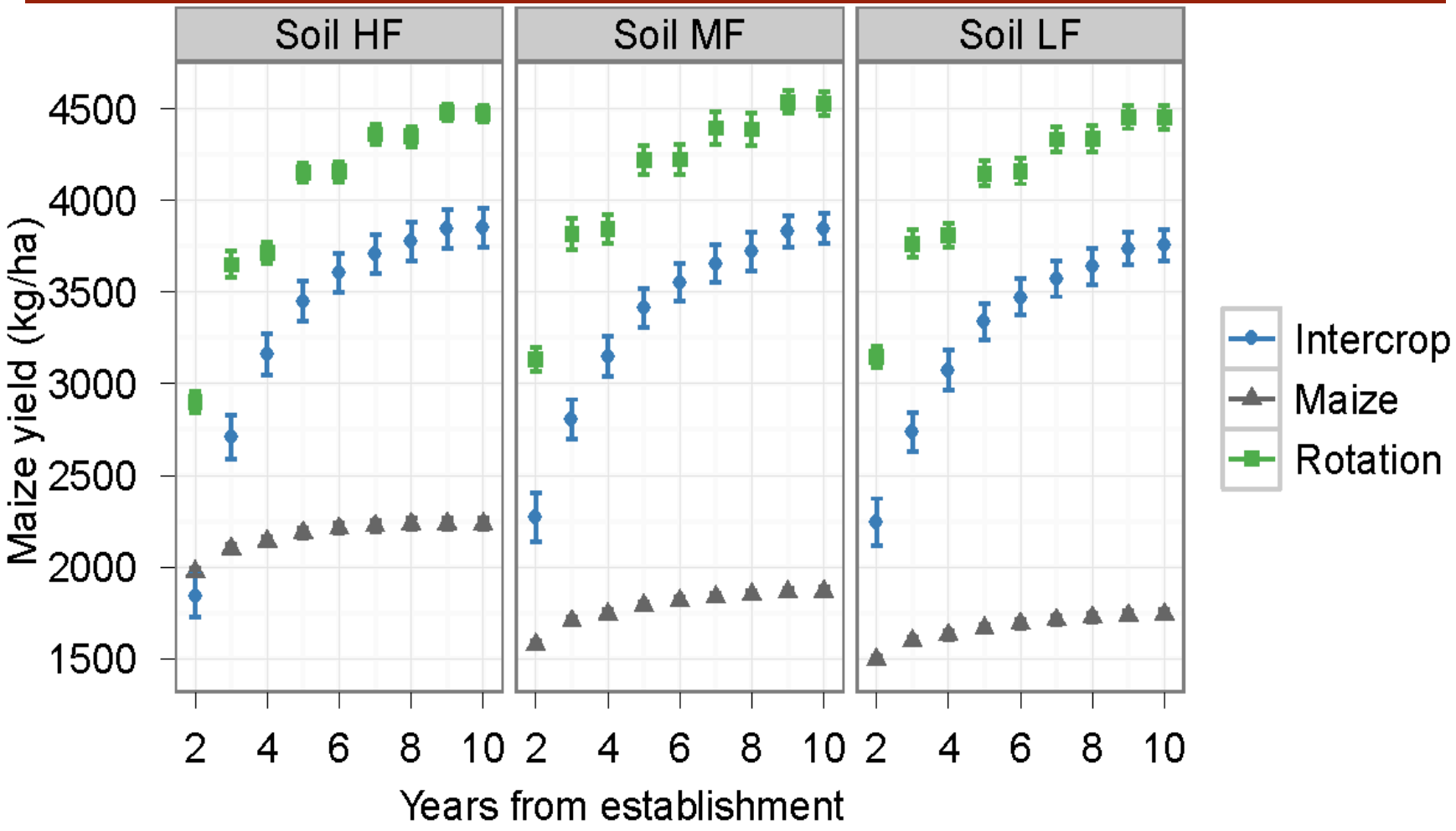
Resilience (Food security)

Yield Variability trial # = 3,300

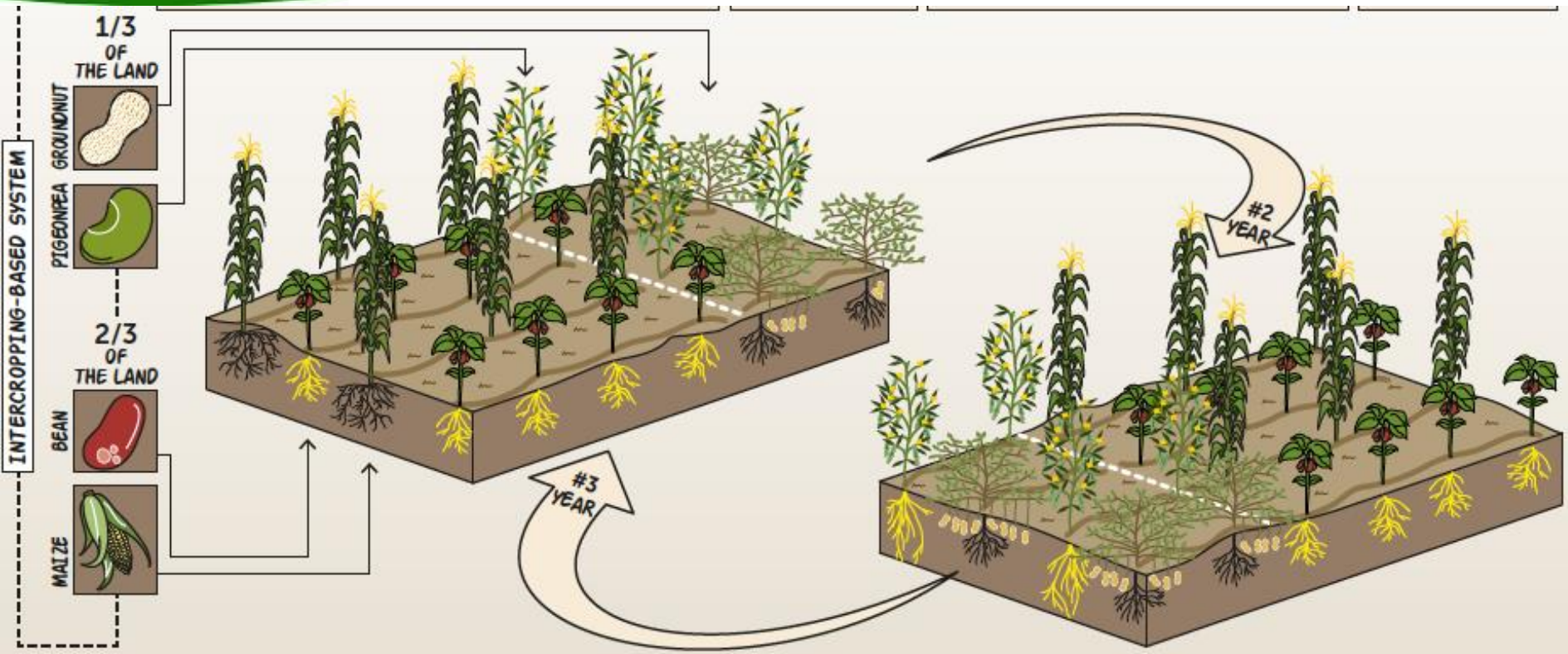


Snapp et al., PNAS 2010

APSIM: Pigeonpea effects on maize yield over a decade



Ollenburger and Snapp, 2014



Pigeonpea biomass has been proven on-farm to provide fuelwood, soil fertility and food. It is the foundational legume in a doubled up legume rehabilitation system where one-third of the farm is dedicated to DUL, followed by a maize-bean intercrop for sustainable intensification (Africa RISING IITA graphic)

Full

Sustainable Intensification

Poor

Soybean & Pigeonpea Varieties + Post-harvest Processing

Intensified Maize, Soybean

Intensified Maize, Food Legu Production

Rehabilitate soils: Doubled Up Legumes, Pigeonpea

Education: Agronomy, Processing, Nutrition & weed management innovation catalyzing

Time

Zikowo [Thanks!]

- MSU: Regis Chikowo, Thom Jayne, Sarah Kooper, Joe Messina, Vicki Morrone, Robbie Richardson
- Cornell: Rachel Bezner Kerr, Laurie Drinkwater
- Univ Greenwich NRI: Kate W. Dyer, Barry Pound
- Univ of Malawi and SFHC: Wezi Mhango, George Kanyama-Phiri, Daimon Kambewa, Lizzie Shumba
- ICRISAT: Eva Weltzien
- Snapp lab: Phil Grabowski, Paul Roge, Erin Anders, Placid Mpeketula, Chiwimbo Gwenambira, Princess Frimpong, Alison Nord, Dan Kane, Rich Price, Alex Smith
- UW: Ken Giller, Mary Ollenburger
- FARMERS

Top Take-aways

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1. **If we want to increase food security and resilience of smallholder farmers in Africa, we need to start by regenerating the productive capacity of the soils.** Farmers can't benefit from the full potential of improved technologies (like fertilizer or improved seed) until/unless they have healthy soil.

2. To restore and protect the productivity of the soil we need to work at both the **landscape and farm level.** We need to support innovations that enhance living soil cover, nitrogen fixation and capture more sunlight to fix carbon. Examples include crop diversification with multipurpose pulses combined with integrated nutrient management.

3. To get **adoption** of regenerative technologies at scale, the **technologies must fit very closely with farmers needs and constraints**, and supportive **policies and incentives must be in place**.

Questions and Answers

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