



# **Conservation agriculture: farmer adoption of new practices and technologies: evidence and lessons learnt**

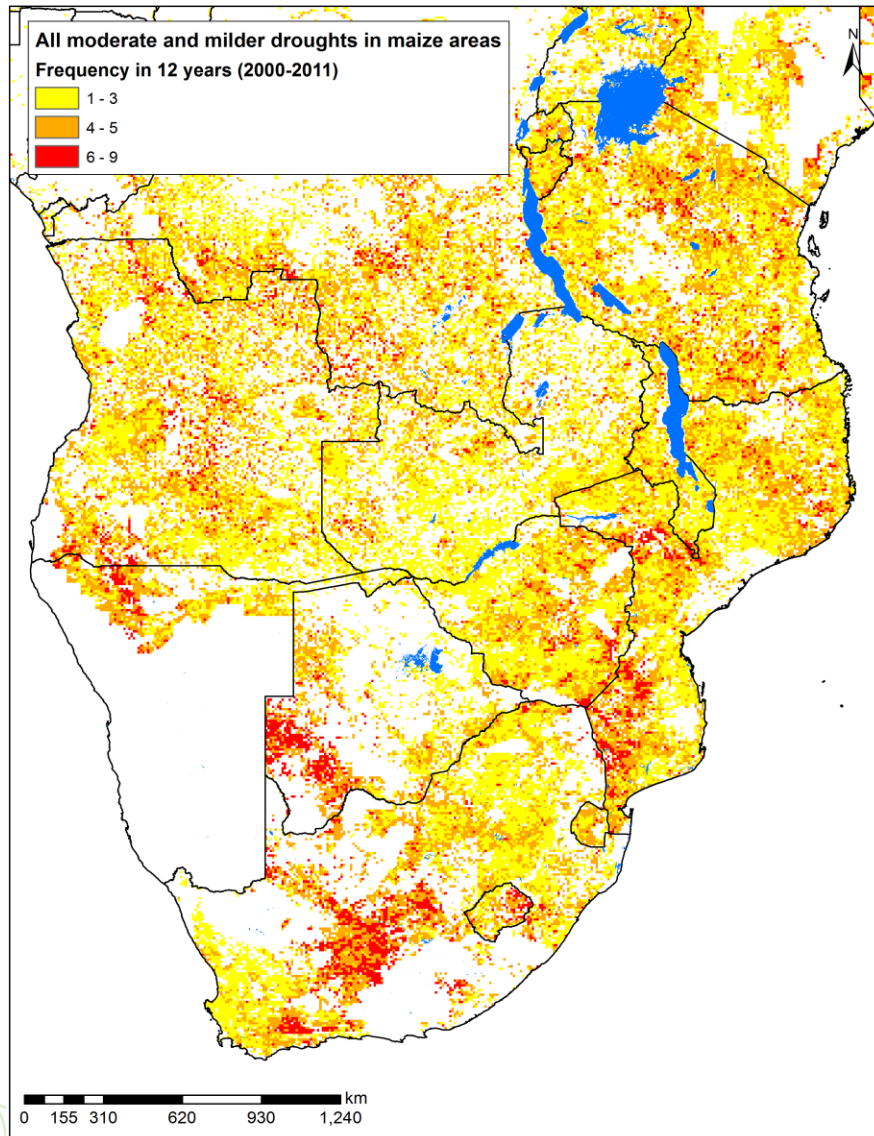
*By Christian Thierfelder*

# Outline of this presentation

- Introduction
- CA and Climate-smart agriculture
- Conservation agriculture – its benefits and challenges
- Scaling and uptake
- Practical examples



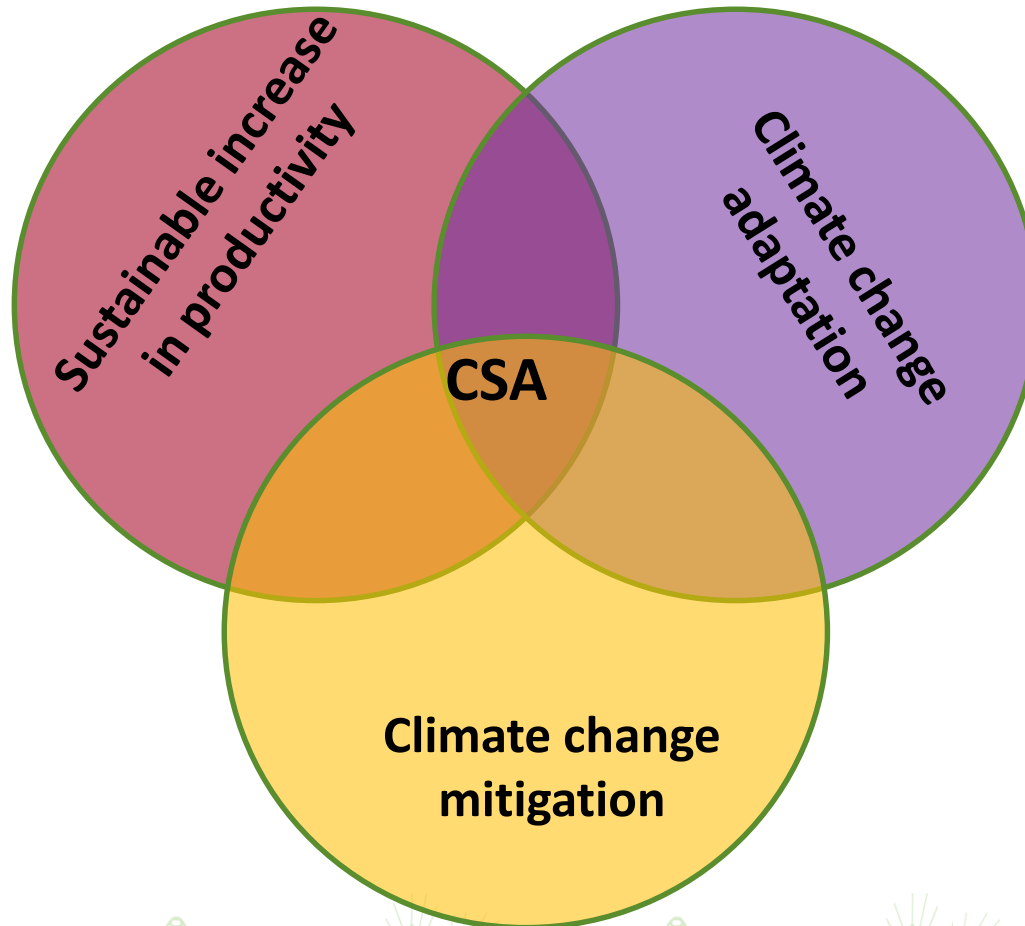
# The Challenges in Africa



Source: Sonder, unpublished



# What do we understand by Climate-smart Agriculture (CSA)?



# What practices could be lumped under the CSA umbrella?

- Conservation agriculture
- Agroforestry (CAWT)
- Rangeland management
- The use of drought-tolerant germplasm
- Targeted fertilizer application
- Improved cattle feeding
- ....



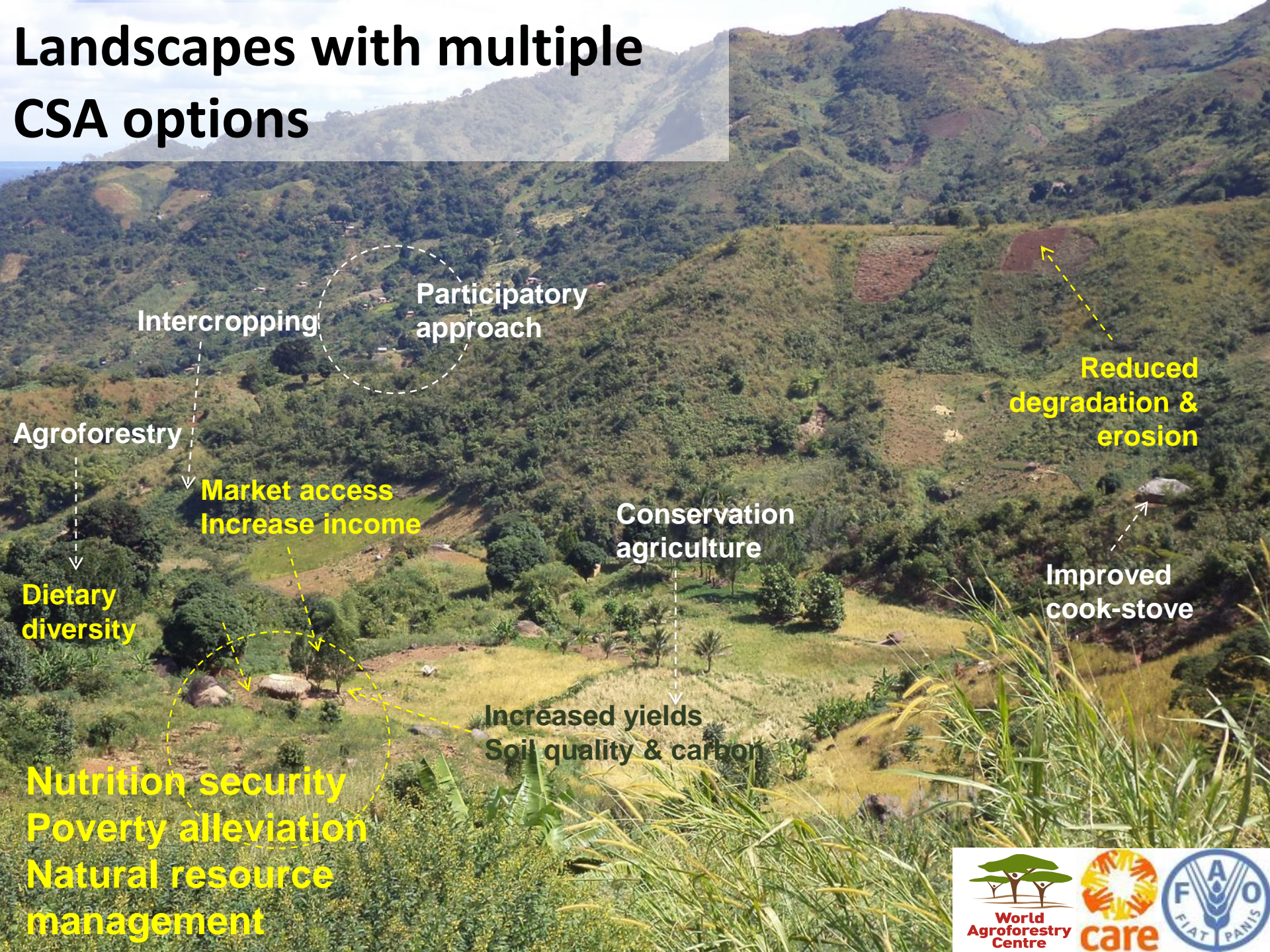
***There is not one CSA practice....***

***but different and complimentary combinations of practices to achieve the greatest CSA potential in a landscape.***

***CA provides a good foundation for CSA!***



# Landscapes with multiple CSA options



Intercropping

Participatory approach

Reduced degradation & erosion

Improved cook-stove

Conservation agriculture

Market access  
Increase income

Increased yields  
Soil quality & carbon

Dietary diversity

Nutrition security  
Poverty alleviation  
Natural resource management



# Why focus on Conservation Agriculture?

- CA reduces **soil and land degradation**
- 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





# CA - a flexible system....



• *Jab-planter*



• *Dibble stick*



• *AT Direct seeder*



• *Hoe-planter*



• *Basin planting*



• *Magoye ripper*

# New Developments for Africa...





***Maize-soybean rotation***



***Groundnuts under CA***



***Cowpeas under CA***



***Maize under CA***

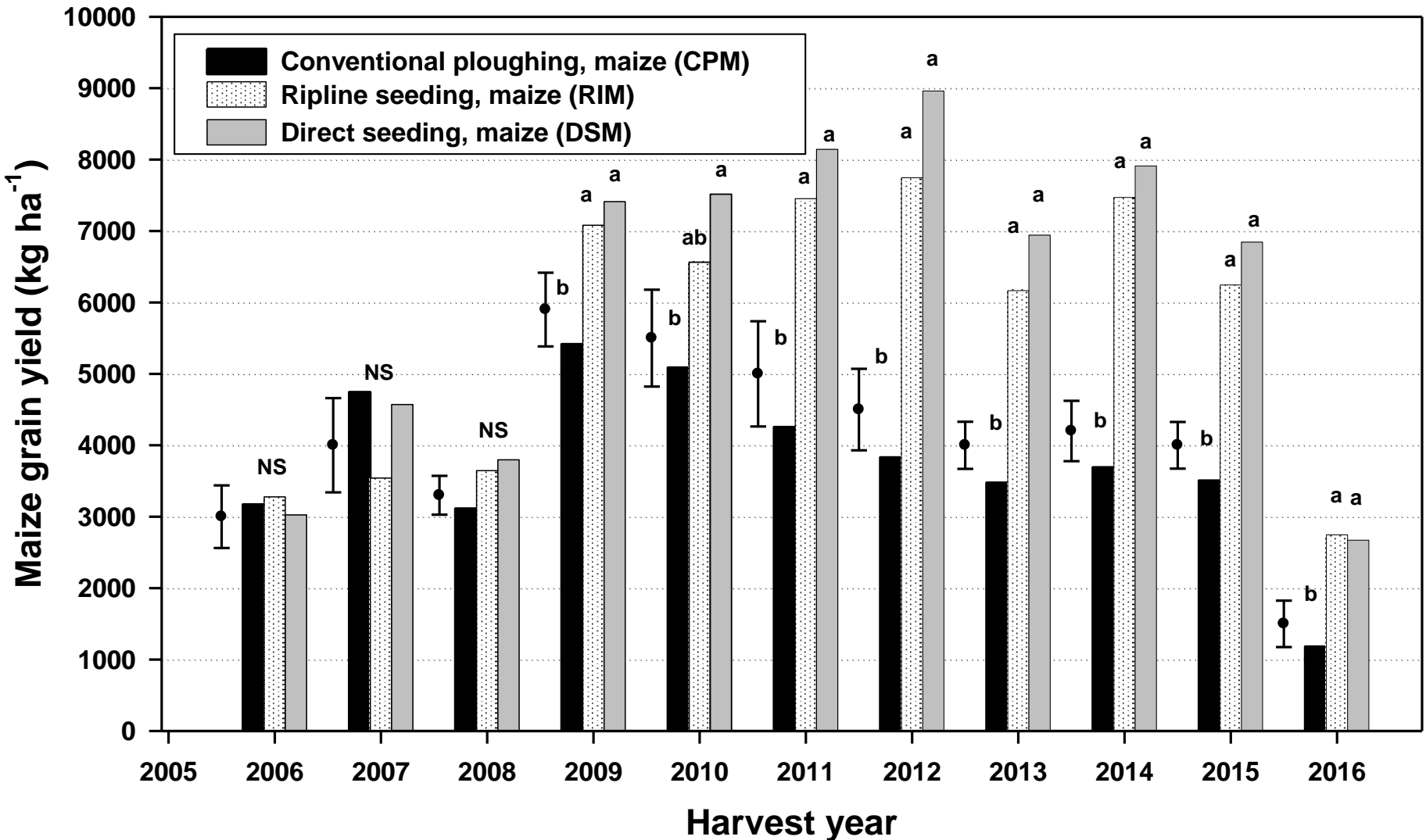


***Maize-Gliricidia intercropping***

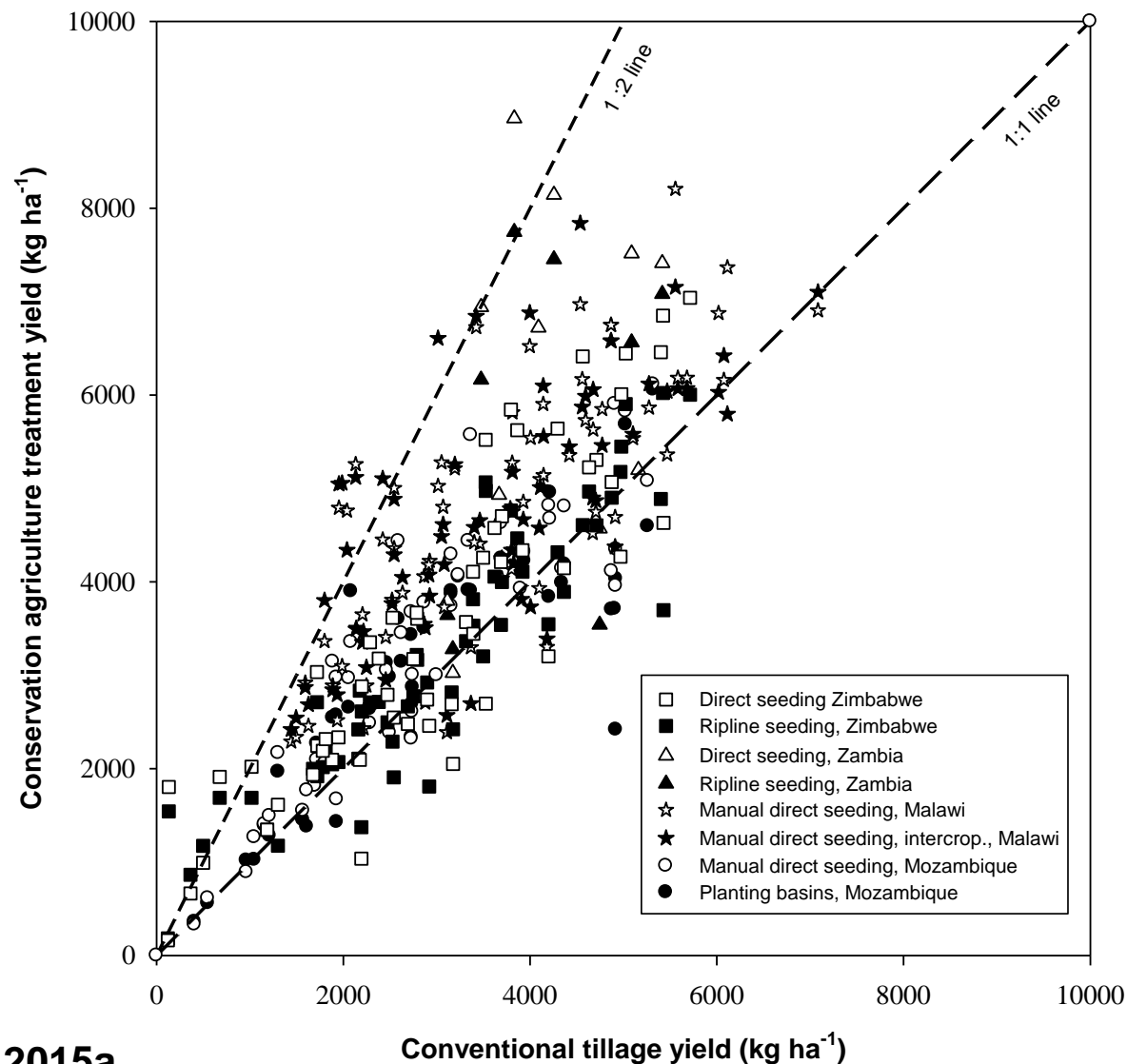


***Maize-groundnut rotation***

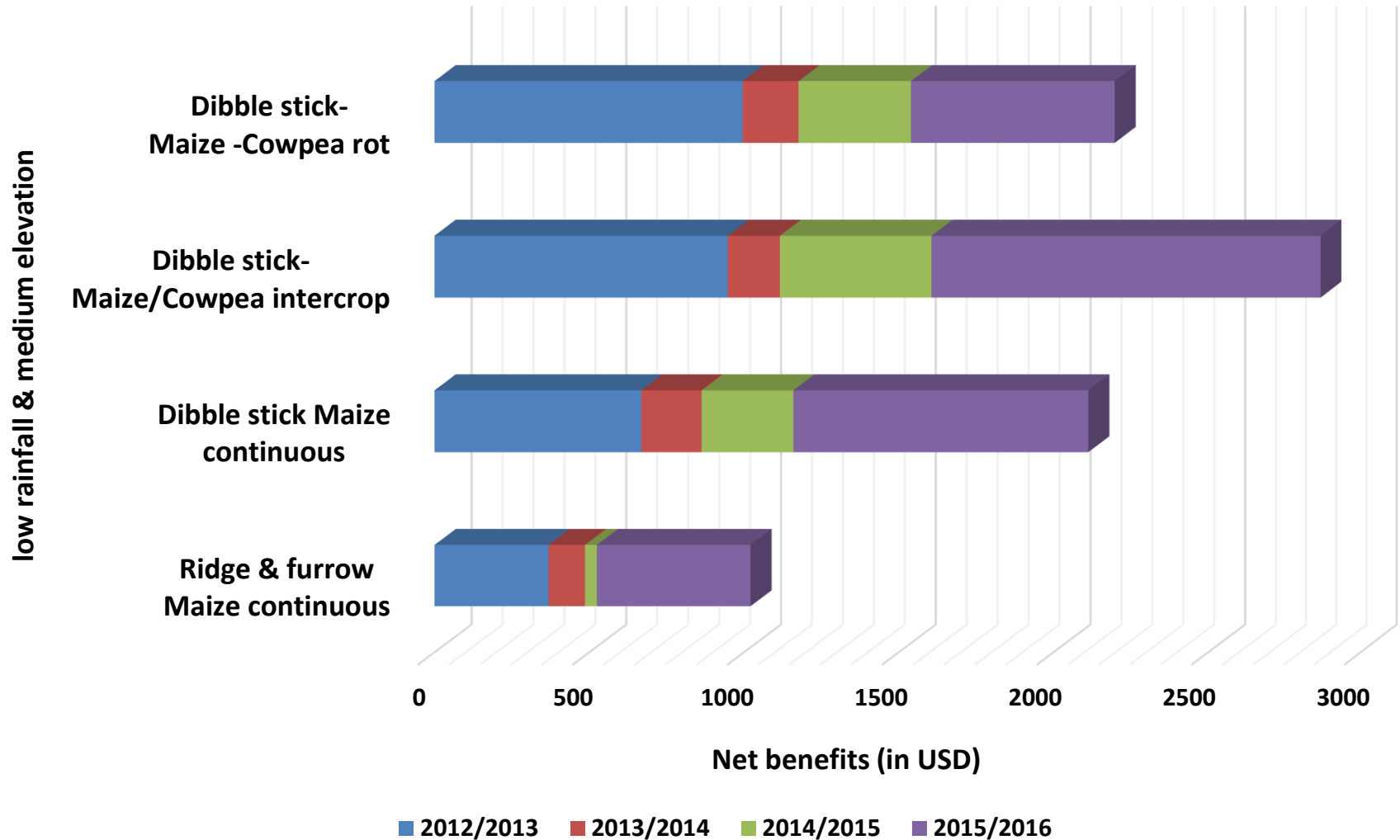
# Longer term maize grain yields on farmers fields in Zambia – Monze, 2006-2016



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

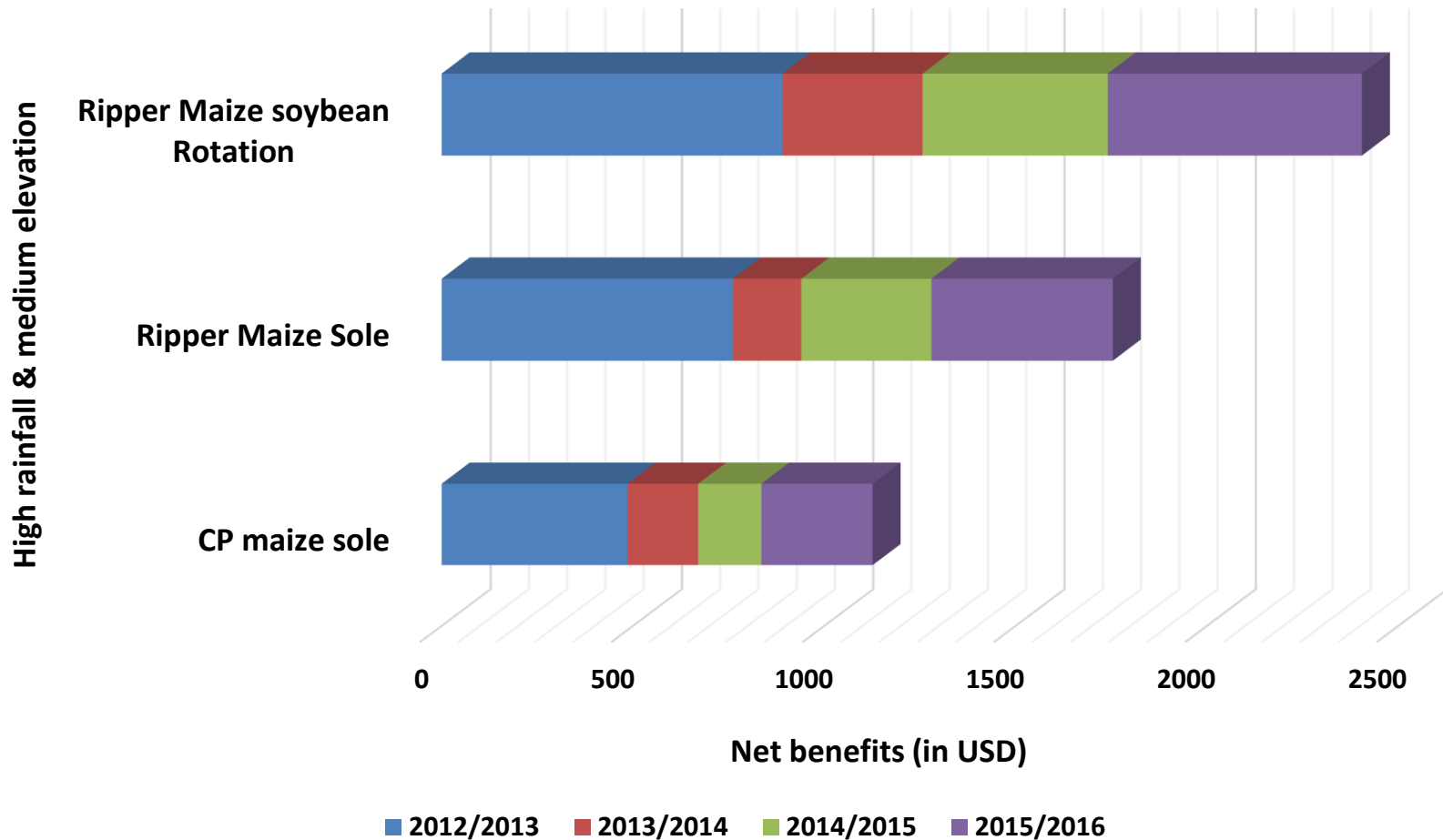


# Manual Sustainable Intensification Practices - Net Benefits (2012-2016), Eastern Zambia

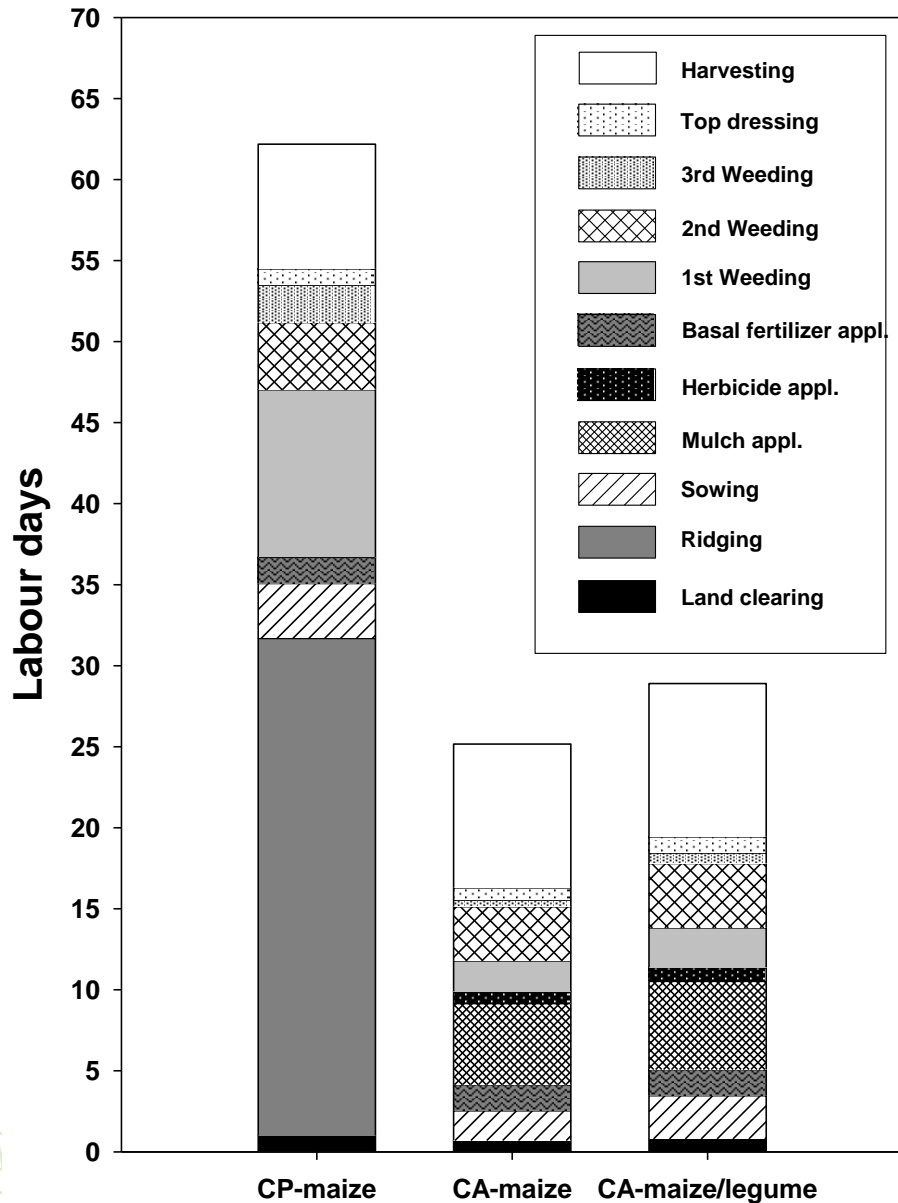


# Mechanised Sustainable Intensification Practices Net Benefits (2012-2016)

## Eastern Zambia



# CA in Malawi - key benefit is labour reduction



Thierfelder et al. 2015b





## Some pertinent challenges ...

- **Residues:** How can we feed both livestock and crops?
- **Weeds** if no herbicides are used
- Lack of **fertilizer** – what are the alternatives?
- Donor driven **adoption** - one-size fits-all approaches
- (S)low adoption – **understanding** the issues



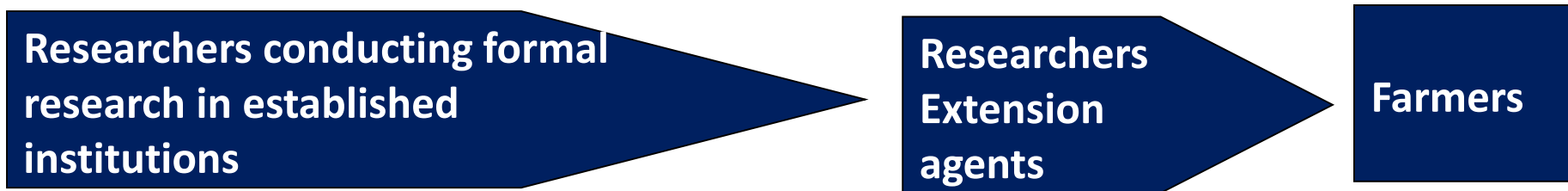
- **Knowledge** gaps and perceptions amongst farmers
- Lack of **evidence** and data taking – believe in myths
- **Targeting** the wrong systems to the wrong farmers
- Ignoring farmers rationale and **decision making**
- The need for **co-development** of technologies



# Scaling and adoption



# The linear vision of research, extension and development



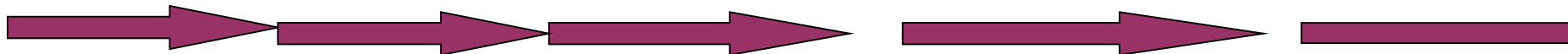
Basic research

Strategic research

Applied research

Technology transfer

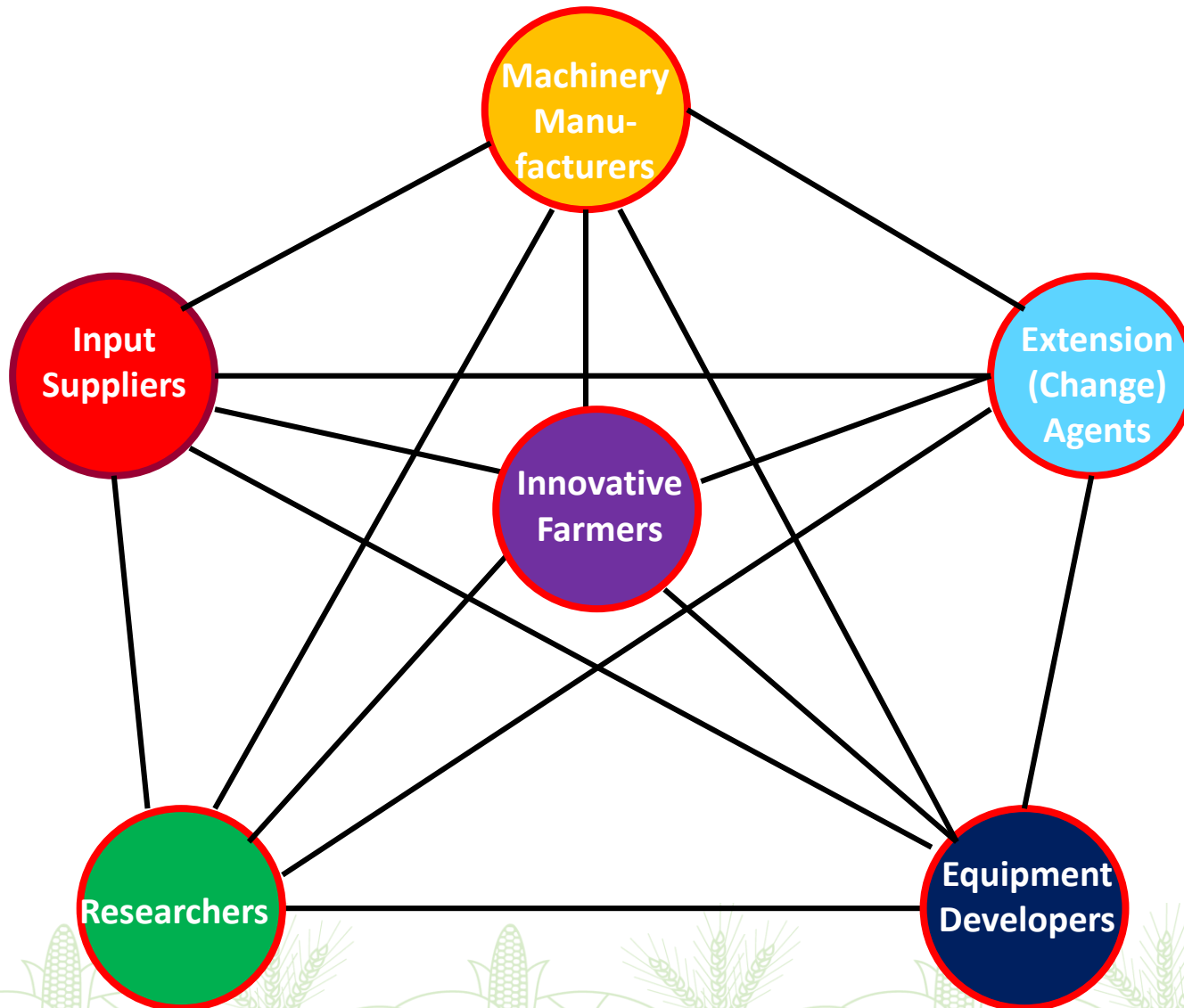
Adoption



Knowledge flow



# For CA, Multi-Agent *Innovation Systems* may be required

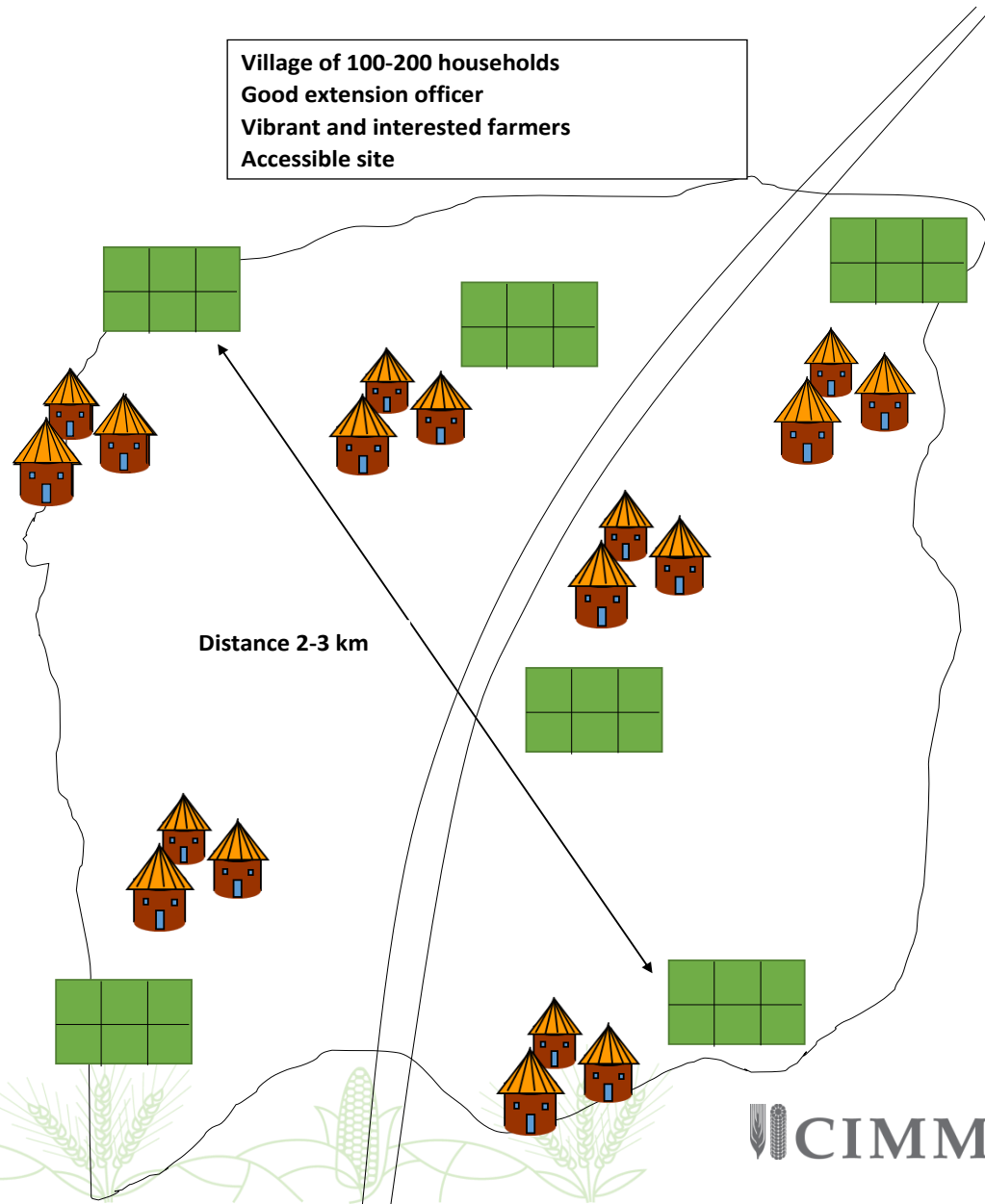


## Other possible players:

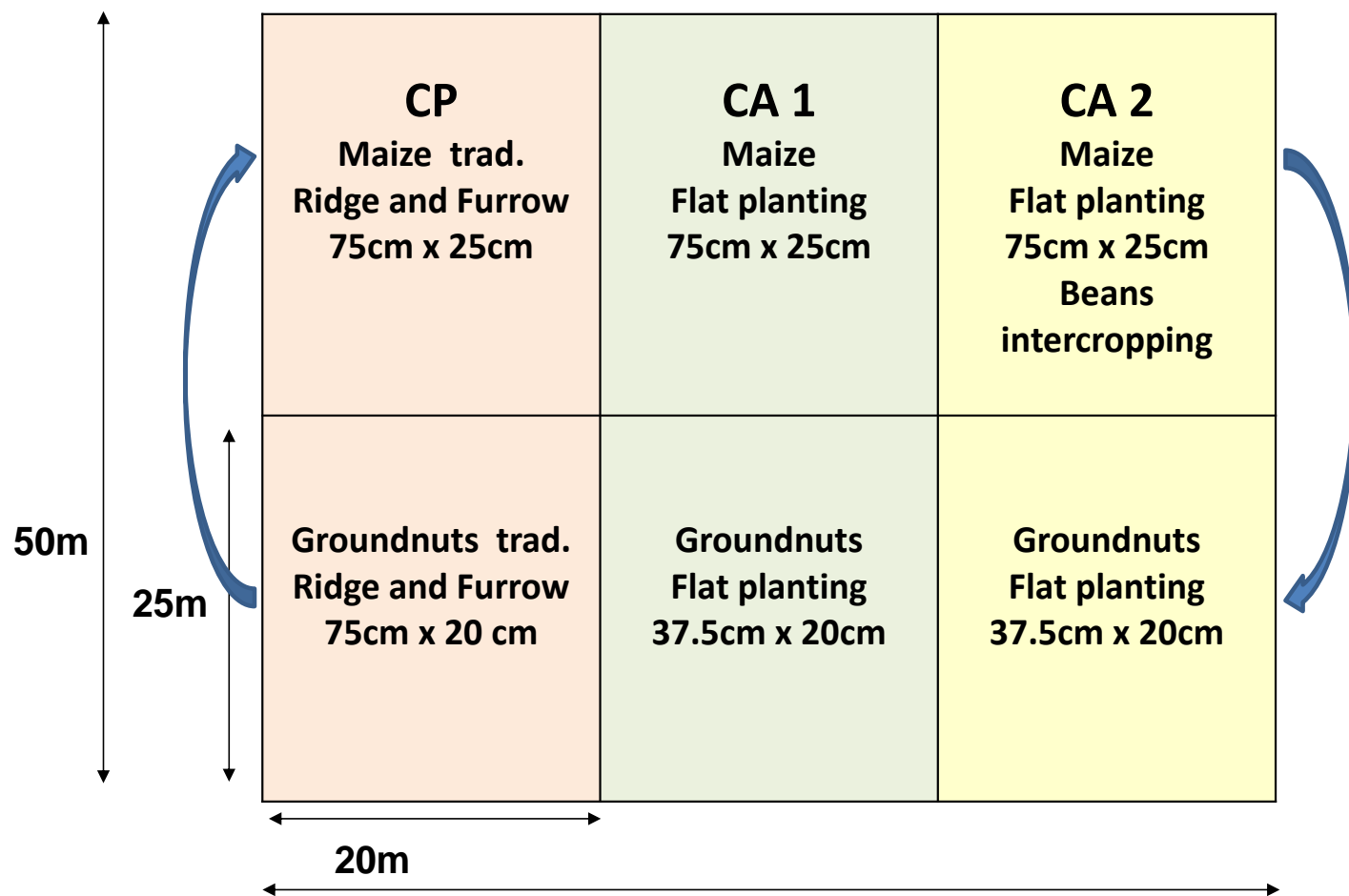
- Agrochemical representatives
- Credit providers
- Output market
- Policy makers
- etc.

# CIMMYT- CA extension in the past

## On-farm Research Cluster approach

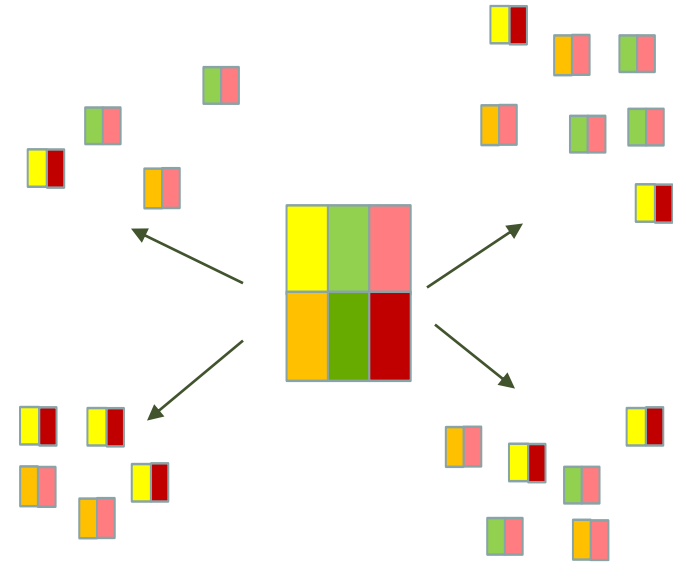


# Maize- groundnut system (6 farmer reps)



# Expanding the niche – through successful scaling

- ✓ Lead farmer approach
- ✓ Demonstration and field days
- ✓ Mother and baby trials
- ✓ Innovation systems approach
- ✓ Participatory extension approaches
- ✓ Farmer-to-farmer exchange
- ✓ Farmer field schools
- ✓ ICT





# 1. How to get started....?

## *Information:*

- Stay **informed** (Get information from experienced farmers and technicians)
- Start **small** (about 10% of the property) with all principles
- Alternatively start with some **key principles**



# Stay informed – technical bulletins and guidelines

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### The Problem of Soil and Land Degradation

**What is soil degradation?**  
Soil degradation is the loss of soil fertility and productivity. It is caused by the loss of soil nutrients, the loss of soil structure, the loss of soil organic matter, and the loss of soil biodiversity. Soil degradation can be caused by natural processes, such as erosion and desertification, or by human activities, such as deforestation, overgrazing, and the use of chemical fertilizers and pesticides. Soil degradation is a global problem that affects the lives of billions of people.



**What is a healthy soil?**  
A healthy soil is one that is able to support plant growth and maintain its structure and fertility. It is rich in organic matter, has a good structure, and is able to hold water and nutrients. A healthy soil is also able to support a diverse community of soil organisms, which helps to maintain its fertility and structure.



**What is soil chemical fertility and how can it be maintained and improved?**  
Soil chemical fertility is the ability of a soil to provide all the nutrients that a plant needs to grow. It is determined by the amount of nutrients in the soil and the ability of the soil to make these nutrients available to the plant. Soil chemical fertility can be maintained and improved by using organic fertilizers, such as compost and manure, and by using chemical fertilizers carefully.

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### Manual and Animal Traction Seeding Systems in Conservation Agriculture

**Seeding crops in conservation agriculture**  
Conservation agriculture (CA) is a farming system that aims to reduce soil erosion and improve soil fertility. It involves using manual or animal traction for seeding, which is a key component of CA. This system is particularly important in developing countries where mechanized farming is not yet widespread.



**Manual systems**  
Manual systems for seeding are used in small-scale farming. They involve using tools like the manual seed drill, which is pulled by a person or an animal. These systems are simple and easy to use, but they can be labor-intensive and may not be as efficient as mechanized systems.



**Seeding tools**  
There are several types of manual seeding tools. The most common is the manual seed drill, which is pulled by a person or an animal. Other tools include the hand sower and the broadcast sower. Each tool has its own advantages and disadvantages, depending on the type of crop and the soil conditions.



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### The Role and Importance of Residues

Conservation agriculture (CA) is a farming system that aims to reduce soil erosion and improve soil fertility. One of the key components of CA is the use of crop residues. Residues play a crucial role in maintaining soil health and improving crop yields.



**What are the benefits of carbon-fixing cover crops?**  
Cover crops are plants that are grown between the main crops. They help to fix carbon in the soil, which improves soil fertility and structure. Cover crops also help to reduce soil erosion and improve water retention in the soil.

- Reduced soil erosion
- Improved soil fertility
- Reduced water requirements
- Increased crop yields
- Reduced soil compaction
- Improved soil structure
- Reduced soil erosion
- Improved soil fertility
- Reduced water requirements
- Increased crop yields

**What is a healthy soil?**  
A healthy soil is one that is able to support plant growth and maintain its structure and fertility. It is rich in organic matter, has a good structure, and is able to hold water and nutrients. A healthy soil is also able to support a diverse community of soil organisms, which helps to maintain its fertility and structure.

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### The Importance of Crop Rotations

**What is a crop rotation?**  
Crop rotation is a farming system that involves growing different crops in the same field in a specific order. This system helps to improve soil fertility and reduce the risk of pests and diseases. Crop rotation is a key component of conservation agriculture.



**What problems does crop rotation solve?**  
Crop rotation helps to solve several problems, including soil erosion, soil fertility, and the risk of pests and diseases. By growing different crops in the same field, farmers can improve the soil and reduce the risk of crop failure.

- Reduced soil erosion
- Improved soil fertility
- Reduced water requirements
- Increased crop yields
- Reduced soil compaction
- Improved soil structure
- Reduced soil erosion
- Improved soil fertility
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- Increased crop yields

**What are the advantages of crop rotation?**  
Crop rotation has several advantages, including improved soil fertility, reduced soil erosion, and increased crop yields. It is a simple and effective way to improve soil health and reduce the risk of crop failure.

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### Conservation Agriculture – a Sustainable System

**What is conservation agriculture?**  
Conservation agriculture (CA) is a farming system that aims to reduce soil erosion and improve soil fertility. It involves using manual or animal traction for seeding, which is a key component of CA. This system is particularly important in developing countries where mechanized farming is not yet widespread.



**What land is suitable for CA?**  
CA is suitable for a wide range of land types, including small-scale farms and large-scale commercial farms. It is particularly suitable for areas with high soil erosion and low soil fertility.

**What crops can be grown under CA?**  
CA can be used to grow a wide range of crops, including cereals, legumes, and vegetables. It is particularly suitable for crops that are sensitive to soil erosion and low soil fertility.

**What benefits can be expected from CA?**  
CA has several benefits, including improved soil fertility, reduced soil erosion, and increased crop yields. It is a simple and effective way to improve soil health and reduce the risk of crop failure.

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### Wood Control in Smallholder Conservation Agriculture

Conservation agriculture (CA) is a farming system that aims to reduce soil erosion and improve soil fertility. One of the key components of CA is the use of crop residues. Residues play a crucial role in maintaining soil health and improving crop yields.



**What are the benefits of wood control in CA?**  
Wood control helps to improve soil fertility and structure, which is essential for CA. It also helps to reduce soil erosion and improve water retention in the soil.

- Reduced soil erosion
- Improved soil fertility
- Reduced water requirements
- Increased crop yields
- Reduced soil compaction
- Improved soil structure
- Reduced soil erosion
- Improved soil fertility
- Reduced water requirements
- Increased crop yields

**What are the challenges of wood control in CA?**  
Wood control can be a challenge in CA, particularly in areas with high wood density. It requires the use of tools and labor, which can be expensive and time-consuming.

## 2. How to get started....?

### *Preparation:*

- **Prepare** the field beforehand (get rid of compaction, unevenness, perennial weeds and acidity problems).
- Obtain the right **equipment** for seeding (and for weed control)
- Produce sufficient **ground cover**.



# 3. How to get started....?

## *Implementation:*

- It is important to achieve good **weed control**.
- Start with a good **crop rotation** to provide nutrients, additional residues and weed control.
- If the soils are very sandy or degraded **apply extra nitrogen** fertilizers, manure or compost.

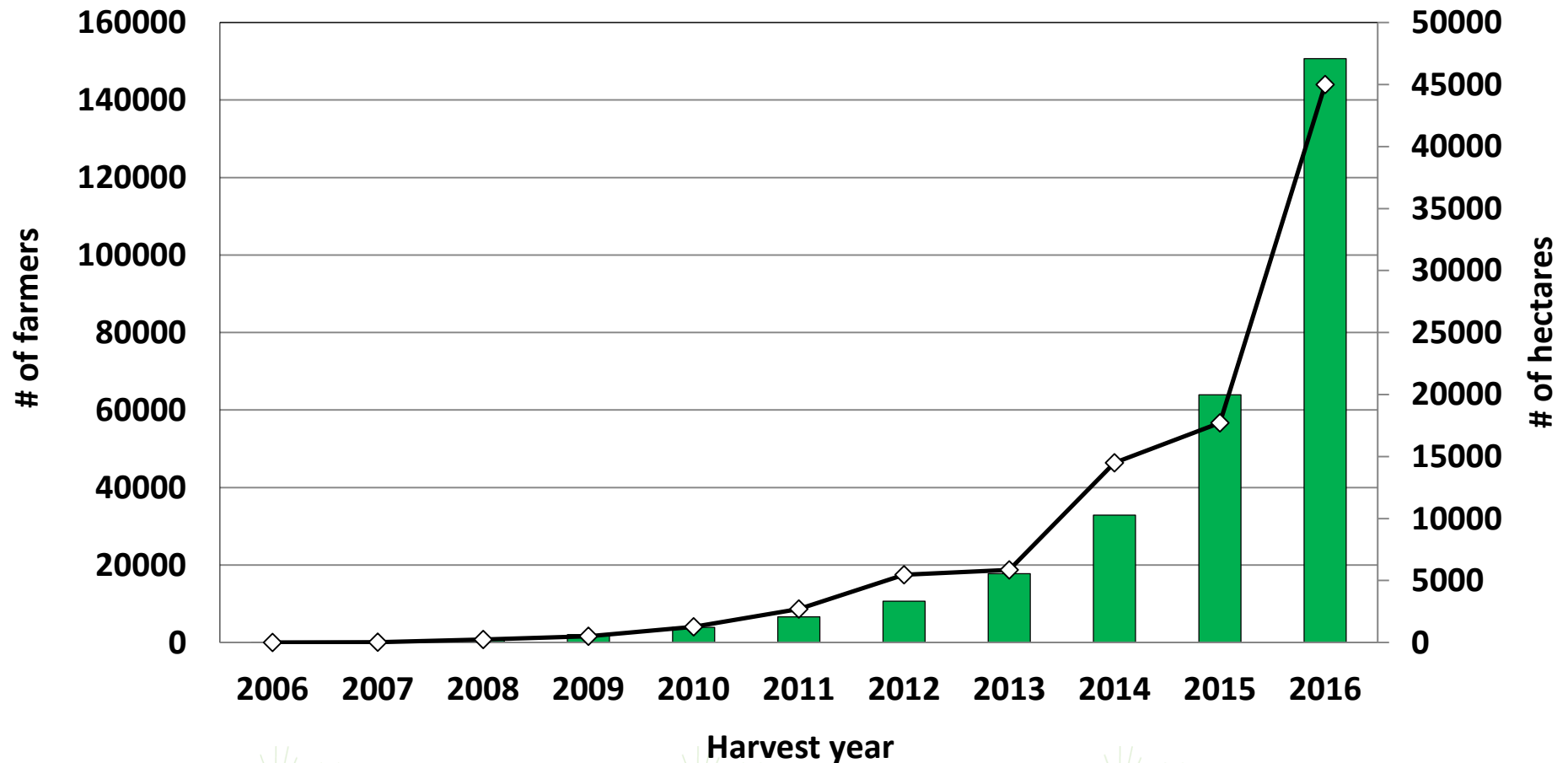


# CA Adoption trends in sub-Saharan Africa

Country	Area under CA (ha)
Lesotho <sup>2</sup>	10,000
Sudan <sup>2</sup>	10,000
Madagascar <sup>2</sup>	6,000
Ghana <sup>2</sup>	30,000
Kenya <sup>2</sup>	32,000
Tanzania <sup>2</sup>	25,000
Malawi <sup>1</sup>	65,000
Mozambique <sup>2</sup>	152,000
Zambia <sup>2</sup>	200,000
Zimbabwe <sup>1</sup>	332,000
South Africa <sup>2</sup>	368,000
<b>Total</b>	<b>1,230,000</b>

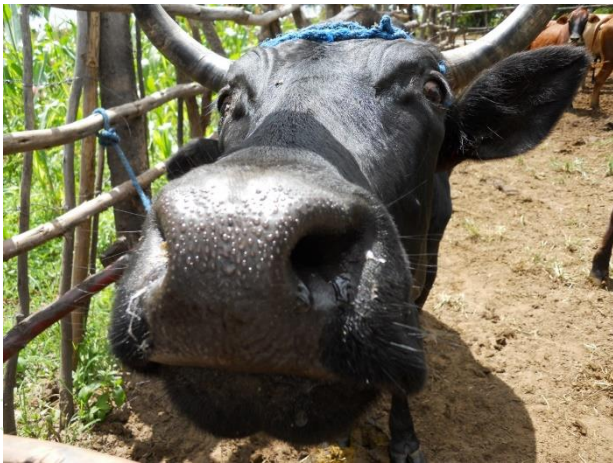
Source: Kassam et al. 2015; <sup>1</sup>2013 estimates; <sup>2</sup>2009 estimates;

# The Lead Farmer approach – Farmers practicing CA with TLC in Malawi



# Reflexions and recommendations

- ✓ CA is **leading CSA system** and well adapted to southern Africa
- ✓ There is no **quick fix or remedy** that leads to 100% adoption CA in a very short time
- ✓ CA has to be promoted in a **flexible** approach – not one-size-fits all – based on good agriculture practices
- ✓ **“Research in Development”** projects can help in solving bio-physical and socio-economic constraints





 **CIMMYT**<sup>MR</sup>  
International Maize and Wheat Improvement Center

**Thank you  
for your  
interest!**

