

# **Conservation Agriculture – the BMP for Sustainable Cotton Production in Africa: Indian Experiences**

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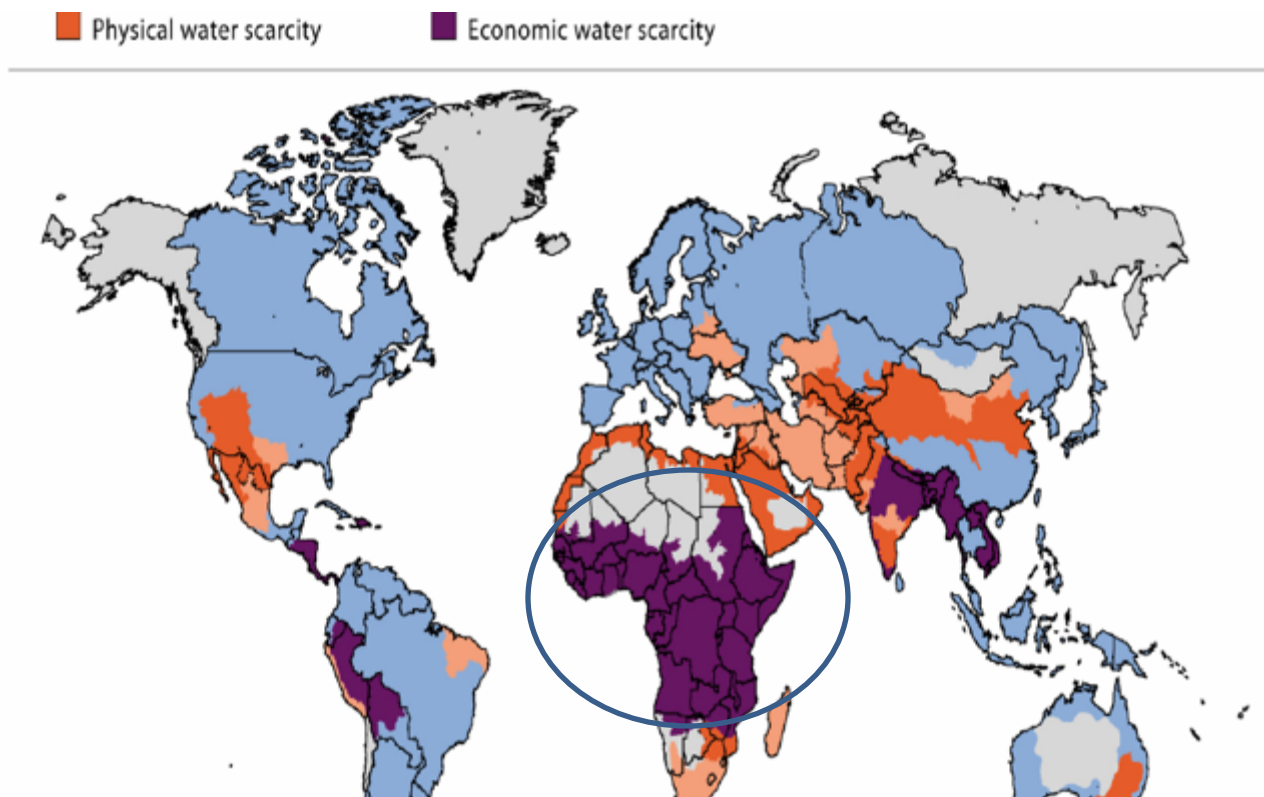
# Outline

- Introduction
- Methodology
- Findings
- Applications to the African context
- Conclusions

# Introduction

- **Productive Soil** - high yields
- **Soil Neglect** leading to deterioration
- **Soil degradation** increasing due to
  1. Increased soil disturbance
  2. Reduced organic additions
  3. Heavy reliance on fertilizer inputs

# Increasing water stress – low productivity



Source: International Water Management Institute  
Adapted from Kumar (2013)

# Can we reverse soil degradation?

- Yes - adopt right management options
- Conservation Agriculture (CA) - Best Management Practices (BMP)

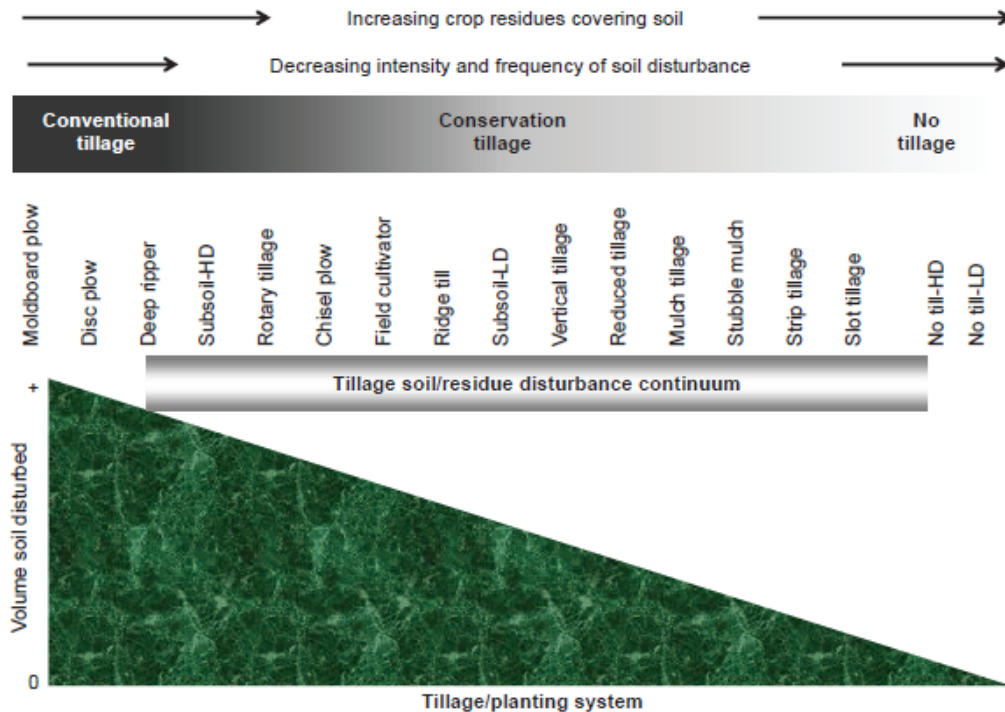
# Conservation Agriculture!!

- CA is based on the following three principles:
  - 1. Minimum soil disturbance**
  - 2. Increased soil cover**
  - 3. Crop rotations**

# Minimum soil disturbance

- Any reduction in tillage from the conventional practice is a form of CA, such as reduced tillage, stubble tillage, no-tillage.

Schematic representation of the volume of soil disturbed with a wide range of conservation tillage (CT)/seeding implements from inversion tillage with the moldboard plow on the left to the low disturbance no-till planter on the right. All forms of CT are between these extremes and are listed in a suggested qualitative order. HD = high disturbance and LD = low disturbance. Source: modified after Friedrich Tebrügge.



# Soil residue cover



- Essential to keep the soil covered with crop residue within the field (rather than removal and burning)
- Because cotton is a low crop residue generating crop, grow a cover crop either before or after cotton.
- Select cover crops that can grow on residual moisture and are drought hardy
- Preferential to grow legumes because of N benefits



# Crop rotations

1. Avoid monocrop for long-term
2. Diversified crop system
3. Legumes - part of the cropping system
4. Include cereals in the rotation – provides benefit of food as well as fodder

# What farmers are doing now?

- Excessive tillage operations
- Hand weeding!!! (production cost increased)
  - Burning crop residues

# Why till the soils?

- Provide a good seed bed - ensures a good crop stand.
- Free of weeds (**possible by using pre-emergence herbicide**)
- Summer plowing - to reduce problem of nematodes and destroy over-wintering population

# Methodology

- Field Experiment continued over 9 years at the same site with a fixed plot layout
- Split Plot Design

Main Plots were Tillage Treatments

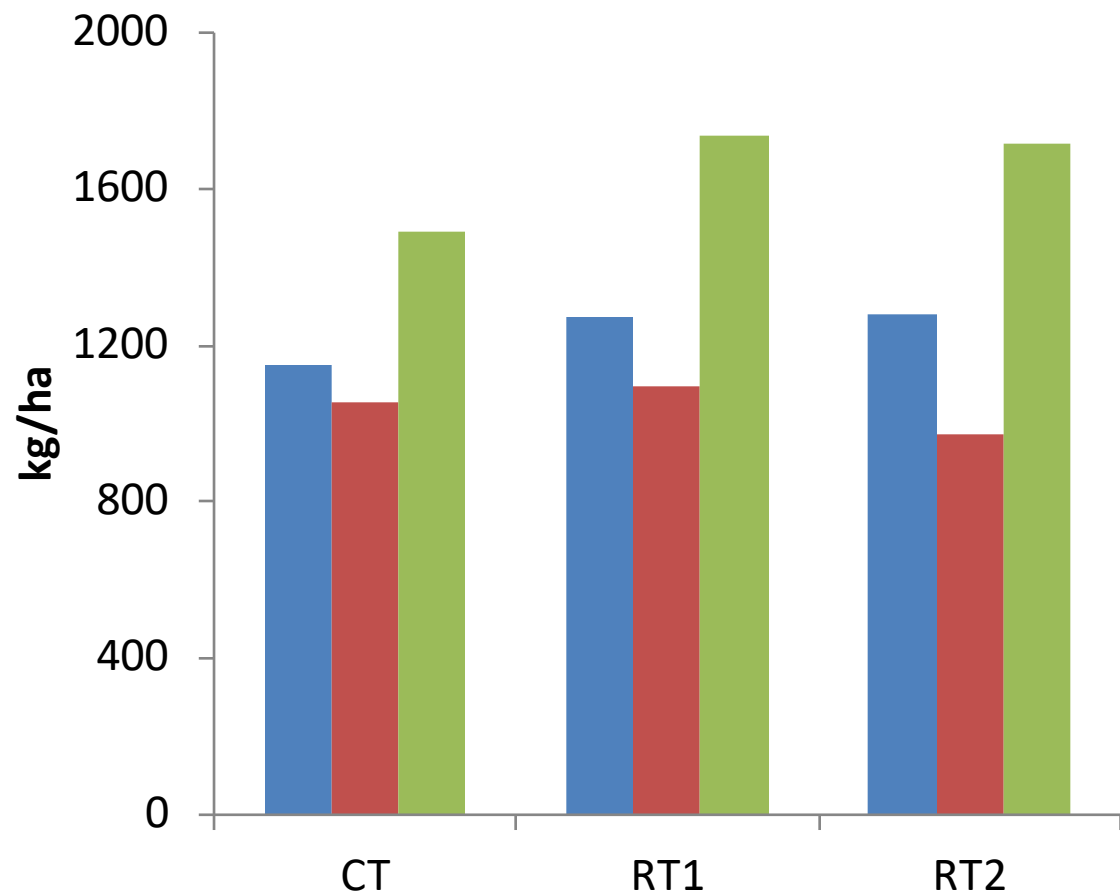
1. Conventional tillage (Farmers practice)
2. Reduced tillage<sub>1</sub> – two hoeing
3. Reduced tillage<sub>2</sub> – no hoeing

Sub-plots

1. Without residue
2. With residue (cotton crop and other crop; legume covers)

# Results

# Seed cotton yield as affected by tillage system over years (1996 to 2008)



- Reduced tillage systems with crop residue recycled yields higher for the Upland cotton cultivars as well as hybrids
- Vice versa for the Asiatic cotton cultivars

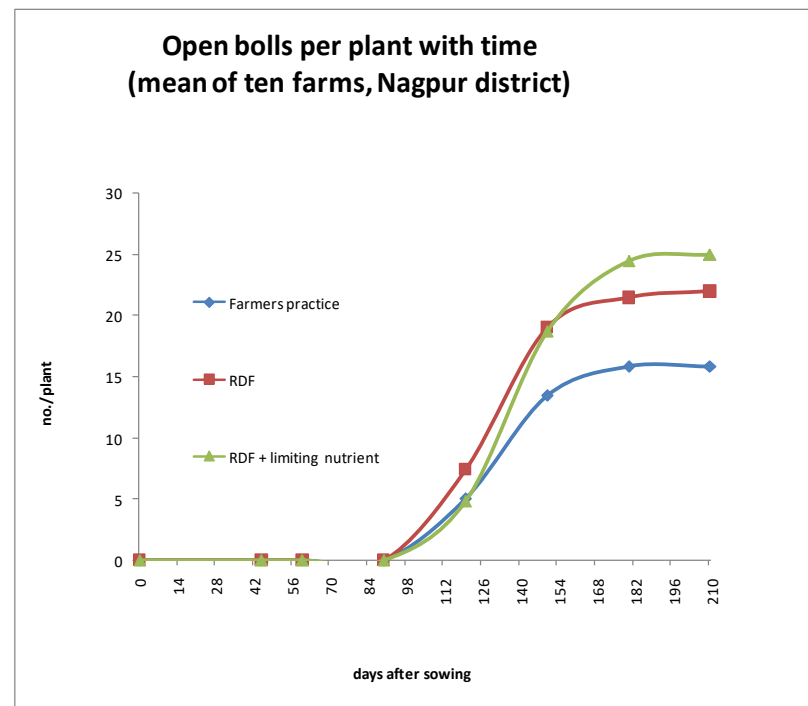
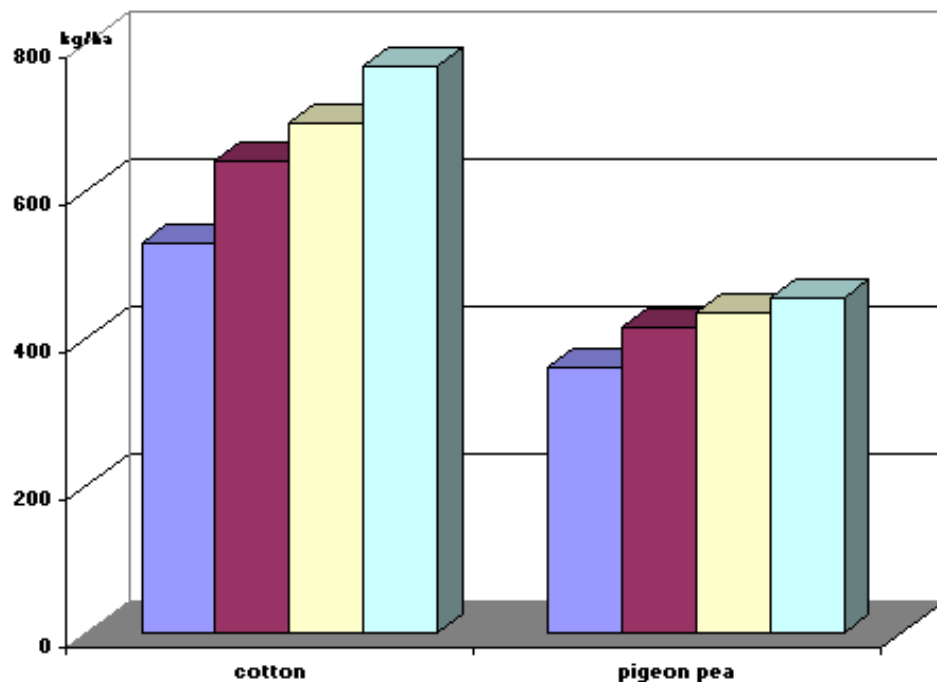
Blaise and Ravindran (2003)

Blaise (2006)

Blaise (2011)

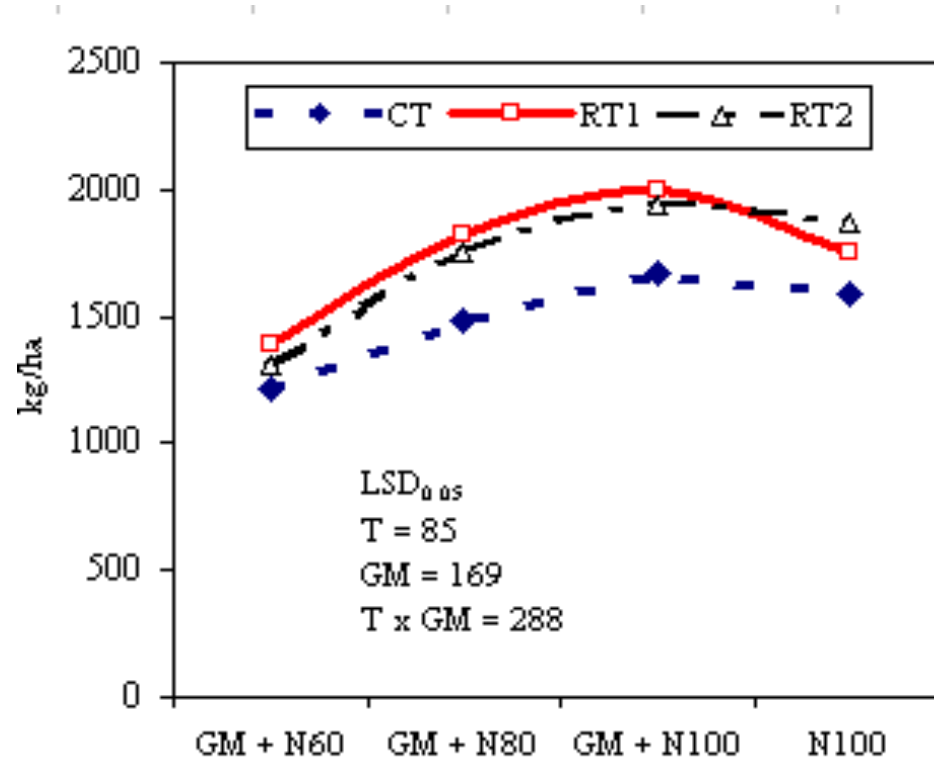
■ Hirsutum cultivar ■ Arboreum cultivar ■ Hirsutum hybrid

# Results of on-farm trials



1. Increased boll retention
2. High seed cotton yields
3. Profitable

# Conservation tillage with legume cover and nitrogen



**CT: Conventional Tillage**

**RT: Reduced Tillage**

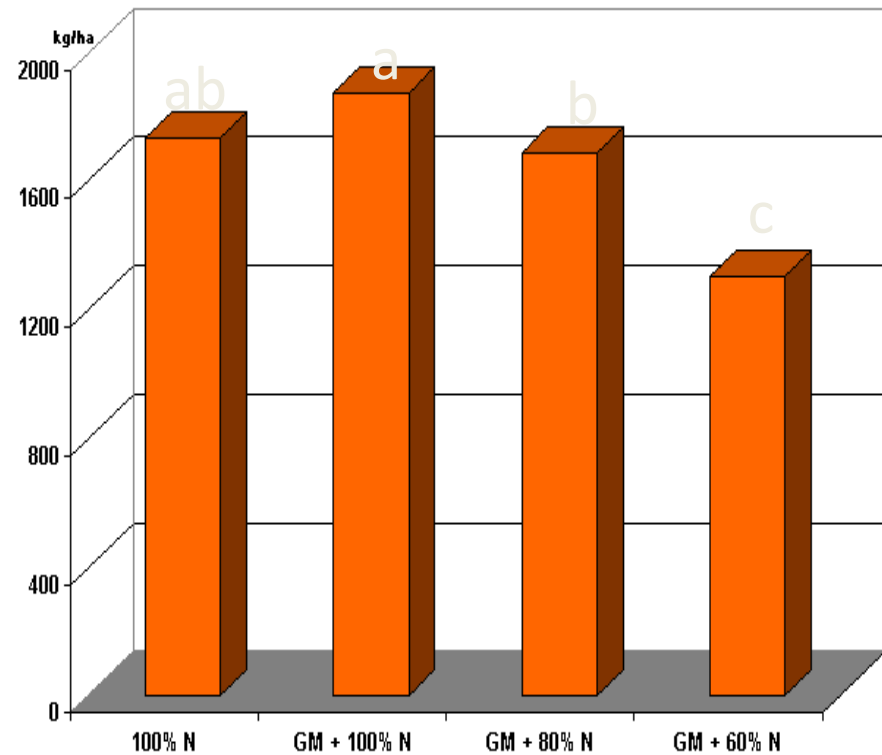
**GM: Live Green manure *In situ***

**N: Nitrogen rates (kg/ha)**

Blaise (2011);  
Blaise et al. (2017)



# Potential to save 20 kg N by in situ green manure



# Impact of cover cropping studies (2012-17)

## Seed cotton yield

1. Generally, Cover plots yielded equivalent to weed free
2. **Pearl millet and Sorghum depressed seed cotton yield when grown as cover crops**
3. Vice versa when applied as mulch
4. Polythene mulch hastened maturity
5. Newspaper mulch as effective as the weed free plot

## Soil Analysis

1. Soil microbiological and biochemical properties were better in the cover crop plots than those without
2. SEM-XRD Analysis done shows better soil aggregation
3. The images also clearly indicate that C accretion increased
4. Furthermore, from the Analysis, O<sub>2</sub> content and pore space was greater in the cover than without cover crop treatments

# New cover and mulch options available

Legumes – native and indigenous

Cereals – sorghum, pearl millet

Oilseeds – sesame

Aromatic plants ???

# Learning Lessons for Africa

- Water scarcity
- Impoverished soils/soil degradation
- Lot of similarities between Africa and the SAT of India –
  1. Mostly rain dependent cotton
  2. Manual labour dependence
  3. Traditional farming systems
- However, traditional and inefficient tools still used in most parts of Africa

# If Conservation Systems are so good, why not followed!!

- Plenty of challenges exist:
  1. Crop residues competing uses for animal and fuel
  2. If herbicide is not used how can we check the weeds
  3. Alternative to fertilizer application
  4. Slow adoption due to understanding
  5. Lack of evidence and data

# What is immediately needed?

- Identify cotton cultivars - short duration and compact growth habit
- Research – collaborative
- Efficient transfer of technology
- Cotton mechanization and **small farm equipment** to improve farm labour efficiency
- Identifying crops that are **indigenous and fix Nitrogen**
- Crops that are compatible with cotton for intercropping

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