Conservation Agriculture

Improving Soil and Human Nutrition in Uncertain Environments

Neil Rowe Miller
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CFGB CA Partners

- 37 African NGOs (projects)
- 10 Canadian NGOs
- 45,000 farmers trained
- 37,000 farmers using CA
- 7,300 spontaneous adopters (known)

Outline

1. Brief Review of Conservation Agriculture Principles
2. Key Strategies for Climate Resilience and Nutritional Diversity
3. Story of Hope

Conservation Agriculture Principles:

1. Maintain Permanent Soil Cover
2. Minimize Soil Disturbance
3. Diversify Crop Associations and Rotations

Maintain Soil Cover

Benefits of Soil Cover: Moisture Retention

Mechanisms of Soil Moisture Retention

- Reduced evaporation
- + Reduced runoff
- = Greater soil moisture

Plant available water under zero tillage and under plough

PHILIPS at al., 1984 cited from STEINER, 1998

From: Steiner. 2002. African Conservation Tillage Network. Information Series No. 4

Soil Cover Reduces Erosion

Fig. 2.1 The relationship between the amount of crop residue retained and soil loss. (Data used were reported by Adekalu et al. 2006, 2007; Lal 1998) **Rusinamhodzi (2015)**

How Much Is *Enough* Soil Cover?

10-
Co

30%
Cover

Cover

2nd Principle:
Minimize Soil Disturbance
(Minimize Tillage)

Ploughing is like a fire which
burns the Soil Organic Matter

Minimum Tillage

Table 16.2
The Effect of 32 Years of Plow and No Tillage under Corn Production on Selected Soil Health Indicators

Soil Health Indicator	Plow-Tillage	No-Tillage
Physical		
Aggregate stability (%)	22	50
*Bulk density (g/cm3)	1.39	1.32
*Penetration resistance (psi)	140	156
Permeability (mm/hr)	2.1	2.4
Plant-available water capacity (%)	29.1	35.7
Infiltration capacity (mm/hr)	1.58	1.63
Chemical		
Early-season nitrate-N (lbs/ac)	13	20
Phosphorus (lbs/ac)	20	21
Potassium (lbs/ac)	88	95
Magnesium (lbs/ac)	310	414
Calcium (lbs/ac)	7,172	7,152
*pH	8.0	7.8
Biological		
Organic matter (%)	4.0	5.4
Cellulose decomposition rate (%/week)	3.0	8.9
Potentially mineralizable nitrogen (µg/g/week)	1.5	1.7
Easily extractable glomalin (mg/g soil)	1.2	1.7
Total glomalin (mg/g soil)	4.3	6.6

Note: Higher values indicate better health, except for those listed with an asterisk, for which lower values are better.
Source: Moebius et al. (2008).

Magdoff, F. and H. van Es. 2009. *Better Soils for Better Crops,*

CA Effects on Soil Health

Figure 2a: Solvita results for Ethiopia (2017 & 2018)

Figure 2c: Solvita results for Tanzania (2017 & 2018)

Source: Scale-Up CA Program, CFGB

3rd Principle: Diversify Crop Rotations and Associations

Intercropping:
Maize-Pigeon Pea

Effect of CA Principles Combined = More than the Sum of Each Alone

- The principles of CA have a larger effect when combined than when used separately.
- 10% + 10% + 10% =
- 50%!!

CA Benefits Increase in Dry Conditions

From: Steiner & Rockström. 2003. African Conservation Tillage Network. Information Series No. 5

Yield Increase with Conservation Agriculture

Complementary management practices: Plant population & establishment

Soil fertility management

Global Uptake of CA

Source: Kassam, *et al*. 2015. *Overview of the Worldwide Spread of Conservation Agriculture*

CA Uptake by Continent

Continent	Cropland under CA (MA ha)	Per cent of global CA area	Per cent of cropland
South America	66.4	42.3	60.0
North America	54.0	34.4	24.0
Australia & NZ	17.9	11.4	35.9
Asia	10.3	6.6	3.0
Russia & Ukraine	5.2	3.3	3.3
Europe	2.0	1.3	2.8
Africa	1.2	0.8	0.9
Global total	157.0	100	10.9

Source: Kassam, *et al*. 2015. *Overview of the Worldwide Spread of Conservation Agriculture*

Key Strategies for Climate Resilience and Nutritional Diversity

- Cover crops
- Crop diversification through CA

Cover Crops
Help Maintain Soil Cover

Drought *Avoidance*
60-Day Cowpea

Q6880B Lablab

Drought Mitigation Mechanisms

60-day cowpea

Lablab purpureus

Main Rains: Pigeon Pea
Intercropped with Sorghum

Short rains: Pigeon Pea Alleys
with Cowpea Intercrop

Pigeon Pea Alleys
with Green Gram Intercrop

A Sustainable GM/CC System Must:

1. Incur minimal cash costs
2. Cause no appreciable increase in labor
3. Provide benefits in addition to improving the soil
4. Have no opportunity cost
5. Cause no significant changes in the existing farming systems

Adapted from: Roland Bunch

CA increases Nutritional Diversity

Mucuna as Live Mulch for Bananas

Early Dry Season Soil Cover

Kishapu Food Security Project, 2014

Kishapu Food Security Project, 2015

Human food