CONSERVATION AGRICULTURE AS A CLIMATE CHANGE RESILIENT OPTION – CASE STUDIES IN ASIA AND AFRICA

Yuji Niino

Food and Agriculture Organization of the United Nations,
Regional Office for Asia and the Pacific
39 Phra Atit Road, Bangkok Thailand 10200 Thailand

Yuji Niino holds a Ph.D. degree in Soil Science from Texas A&M University (USA) and is a Land Management Officer of the Food and Agriculture Organization of the United Nations (UN-FAO) Regional Office for Asia and the Pacific (RAP). He is in charge of promoting sustainable land use and management, soil and water conservation and soil productivity improvement.

ABSTRACTS

Natural ecosystems, in their altered states, have always been relied upon to support continuity of agriculture production and ecosystem services such as flood and erosion control, mediation of water quality, stream flow regulation, microclimate regulation, and biodiversity in its various forms. Improper agricultural practices can reduce the ability of ecosystems to provide food and other services. But efforts to promote food security and environmental sustainability can often reinforce each other and enable all farmers to adapt to and mitigate the impact of climate change and other stresses. Some of these efforts would be based on appropriate technologies such as Conservation Agriculture (CA) and practices that restore natural ecosystems and improve the resilience of farming systems, thus enhancing food security.

CA principles translate into a number of locally-devised and applied practices that work simultaneously through contextualized crop-soil-water-nutrient-pest-ecosystem management at a variety of scales. According to FAO (2008, 2012), the adoption of CA has resulted in savings in machinery, energy use and carbon emissions, a rise in soil organic matter content and biotic activity, less erosion, increased crop-water availability and thus resilience to drought, improved recharge of aquifers and reduced impact of the variability in weather associated with climate change (drought, floods, heat, cold).

In Asia and the Pacific region, the rate of increase in crop yields has slowed and yield gains are becoming difficult to maintain because of the degradation of land and water resources upon which agriculture is depends. In the region, agriculture in general has been changing from traditional subsistence farming to 'modern' commercial farming at different rates in different nations. This has led to specialization in commercialized farming with mechanization, intensive tillage and increased agrochemical use, leading to destruction of soil health and soil ecosystem functions. The use of high levels of external inputs and labour-saving technologies has resulted, in some cases, to abandoning some of the important ecologically-based practices such as crop rotation and diversified cropping (Kassam et al. 2014).

The agro-ecosystems in Africa are facing increasing pressures as a result of rapid population growth, agricultural and livestock intensification characterised by progressive reduction in farm sizes, and unsustainable land use and management practices. The land and freshwater resource base, associated biodiversity and populations whose livelihoods and food security depend on those resources, are threatened by land degradation, declining productive capacity of croplands and rangelands, deforestation and encroachment of agriculture into wetlands. Climate change and variability aggravates these threats.

KEYWORDS

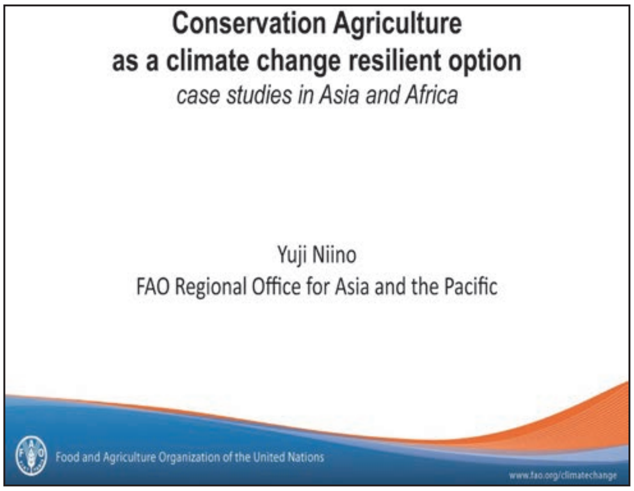
Conservation Agriculture, Land Degradation, Climate Change, Sustainable Land Management, Sustainable Crop Production Intensification

REFERENCES

FAO. 2008. Investing in sustainable crop intensification: The case for improving soil health. Report of the International Technical Workshop, FAO, Rome, July 2008. Integrated Crop Management Vol. 6, FAO, Rome (www.fao.org/ag/ca/)

FAO. 2012. FAO CA website at: www.fao.org/ag/ca.

Kassam, A., H. Li, Y. Niino, T. Friedrich, J. He and X. Wang, 2014: International Journal of Agricultural and Biological Engineering, 7(5):1-13.



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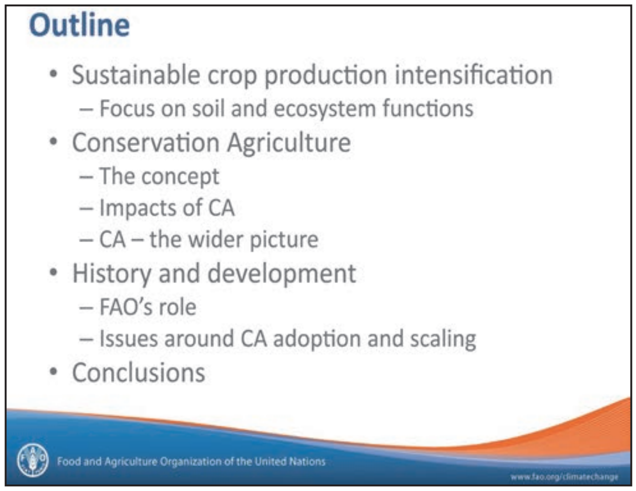

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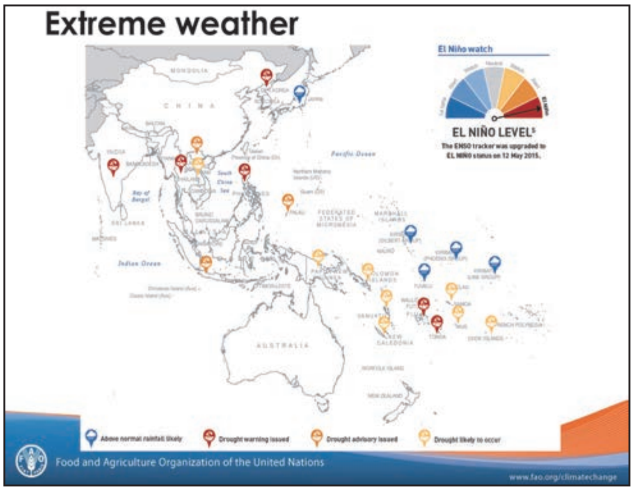

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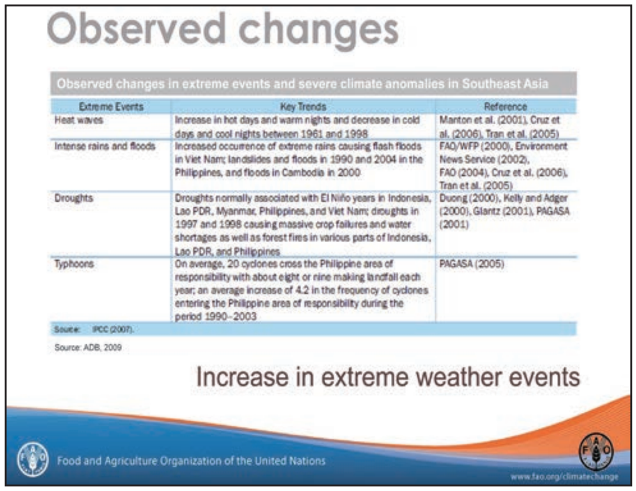

Observed changes

Observed changes in extreme events and severe climate anomalies in Southeast Asia

Extreme Events	Key Trends	Reference
Heat waves	Increase in hot days and warm nights and decrease in cold days and cool nights between 1961 and 1998	Manton et al. (2001), Cruz et al. (2006), Tran et al. (2005)
Intense rains and floods	Increased occurrence of extreme rains causing flash floods in Viet Nam; landslides and floods in 1990 and 2004 in the Philippines, and floods in Cambodia in 2000	FAO/WFP (2000), Environment News Service (2002), FAO (2004), Cruz et al. (2006), Tran et al. (2005)
Droughts	Droughts normally associated with El Niño years in Indonesia, Lao PDR, Myanmar, Philippines, and Viet Nam; droughts in 1997 and 1998 causing massive crop failures and water shortages as well as forest fires in various parts of Indonesia, Lao PDR, and Philippines	Duong (2000), Kelly and Adger (2000), Glantz (2001), PAGASA (2001)
Typhoons	On average, 20 cyclones cross the Philippine area of responsibility with about eight or nine making landfall each year; an average increase of 4.2 in the frequency of cyclones entering the Philippine area of responsibility during the period 1990–2003	PAGASA (2005)

Source: IPCC (2007).

Source: ADB, 2009

Increase in extreme weather events

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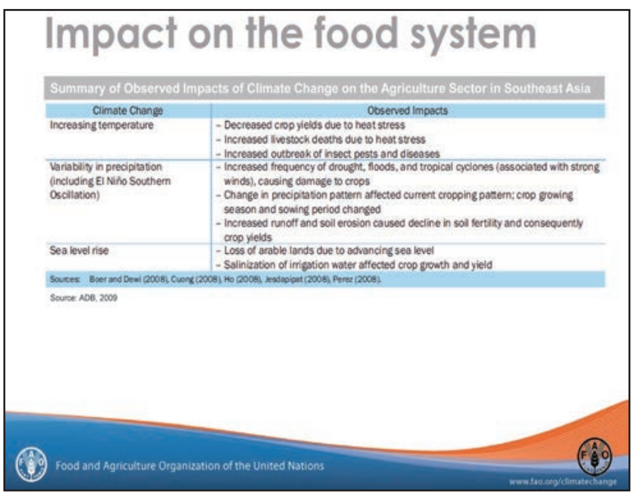

Impact on the food system

Summary of Observed Impacts of Climate Change on the Agriculture Sector in Southeast Asia

Climate Change	Observed Impacts
Increasing temperature	- Decreased crop yields due to heat stress - Increased livestock deaths due to heat stress - Increased outbreak of insect pests and diseases
Variability in precipitation (including El Niño Southern Oscillation)	- Increased frequency of drought, floods, and tropical cyclones (associated with strong winds), causing damage to crops - Change in precipitation pattern affected current cropping pattern; crop growing season and sowing period changed - Increased runoff and soil erosion caused decline in soil fertility and consequently crop yields
Sea level rise	- Loss of arable lands due to advancing sea level - Salinization of irrigation water affected crop growth and yield

Sources: Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008), Perez (2008).

Source: ADB, 2009

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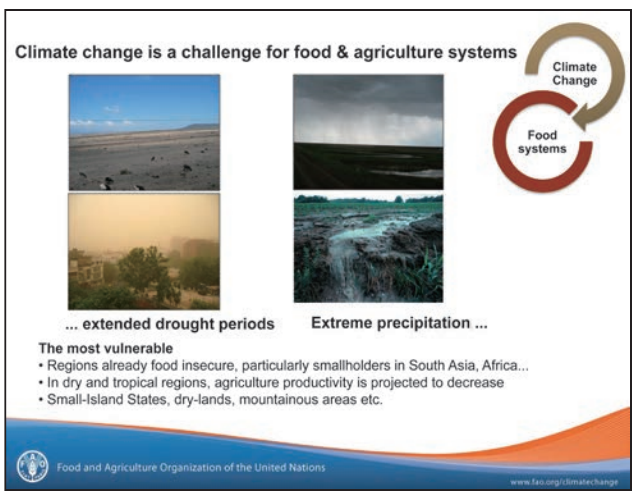

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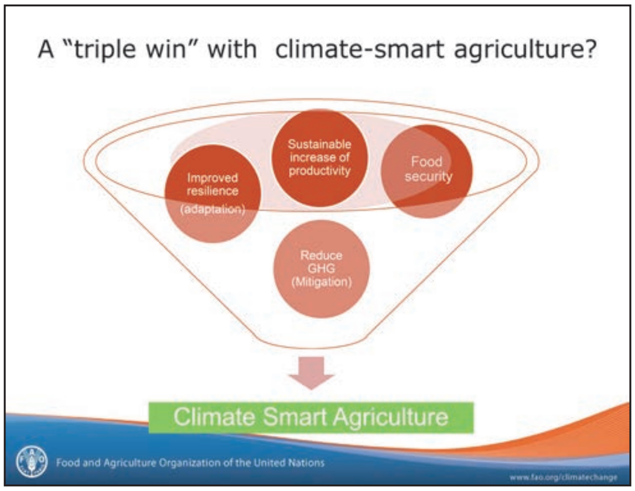
A "triple win" with climate-smart agriculture?
Sustainable increase of productivity
Improved resilience (adaptation)
Food security
Reduce GHG (Mitigation)
Climate Smart Agriculture
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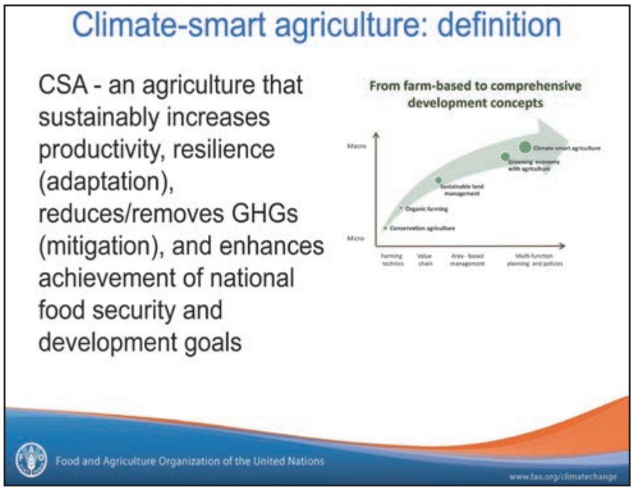
Climate-smart agriculture: definition
CSA - an agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances achievement of national food security and development goals
From farm-based to comprehensive development concepts
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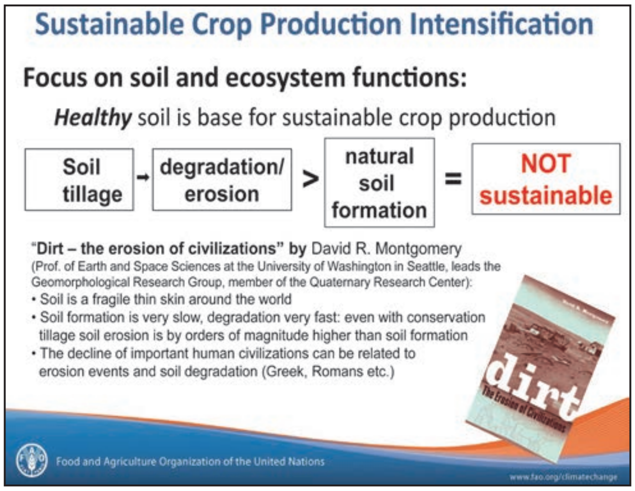
Sustainable Crop Production Intensification
Focus on soil and ecosystem functions:
Healthy soil is base for sustainable crop production
Soil tillage
degradation/ erosion
>
natural soil formation
=
NOT sustainable
"Dirt – the erosion of civilizations" by David R. Montgomery
(Prof. of Earth and Space Sciences at the University of Washington in Seattle, leads the Geomorphological Research Group, member of the Quaternary Research Center):
• Soil is a fragile thin skin around the world
• Soil formation is very slow, degradation very fast: even with conservation tillage soil erosion is by orders of magnitude higher than soil formation
• The decline of important human civilizations can be related to erosion events and soil degradation (Greek, Romans etc.)
dirt
The Erosion of Civilizations
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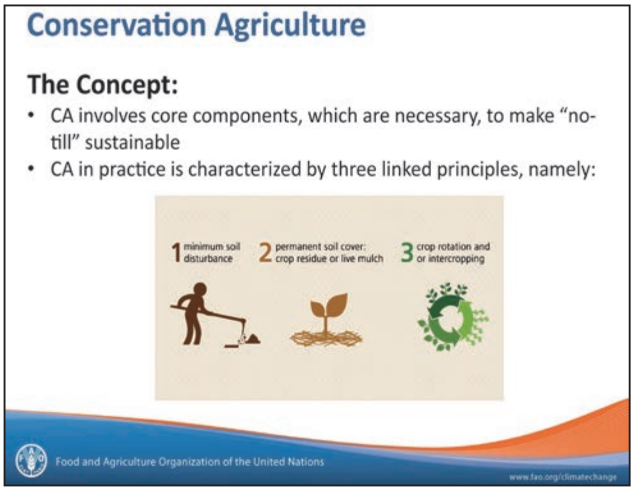
Conservation Agriculture
The Concept:
• CA involves core components, which are necessary, to make "no-till" sustainable
• CA in practice is characterized by three linked principles, namely:
1 minimum soil disturbance
2 permanent soil cover: crop residue or live mulch
3 crop rotation and or intercropping
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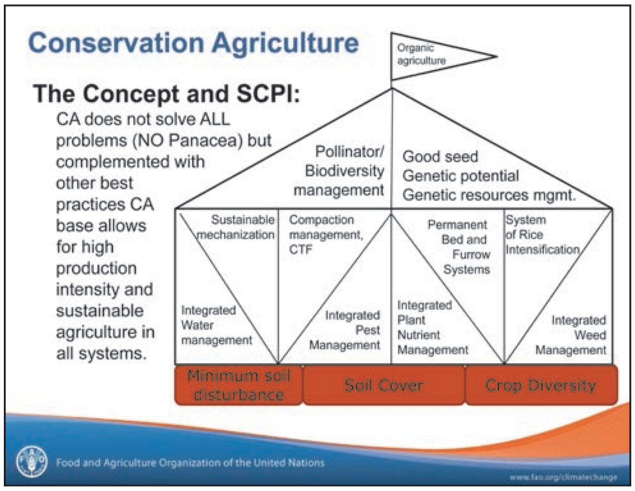
Conservation Agriculture
The Concept and SCPI:
CA does not solve ALL problems (NO Panacea) but complemented with other best practices CA base allows for high production intensity and sustainable agriculture in all systems.
Organic agriculture
Pollinator/ Biodiversity management
Good seed Genetic potential Genetic resources mgmt.
Sustainable mechanization
Compaction management, CTF
Permanent Bed and Furrow Systems
System of Rice Intensification
Integrated Water management
Integrated Pest Management
Integrated Plant Nutrient Management
Integrated Weed Management
Minimum soil disturbance
Soil Cover
Crop Diversity
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Conservation Agriculture
Drivers for adoption:
• Erosion: North America, Brazil, China
• Drought: China, Australia, Kazakhstan, Zambia
• Cost of production: global
• Ecosystem services: global
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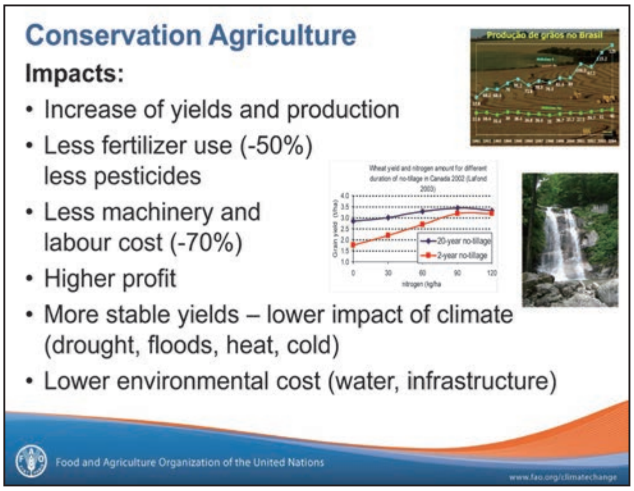

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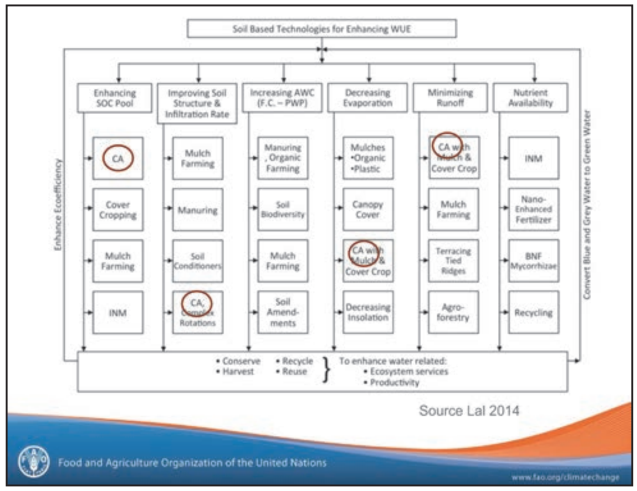

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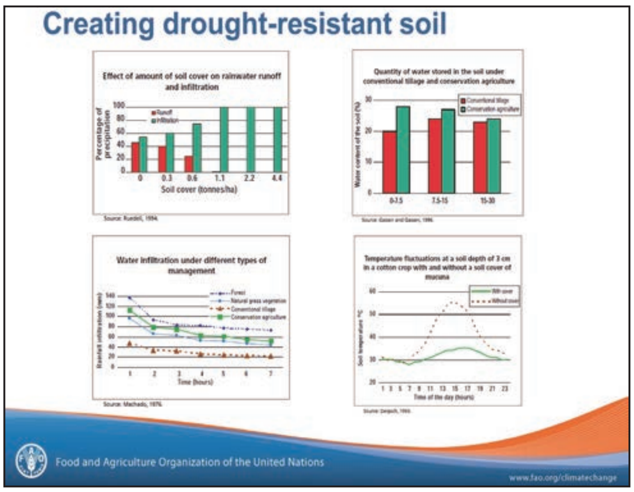

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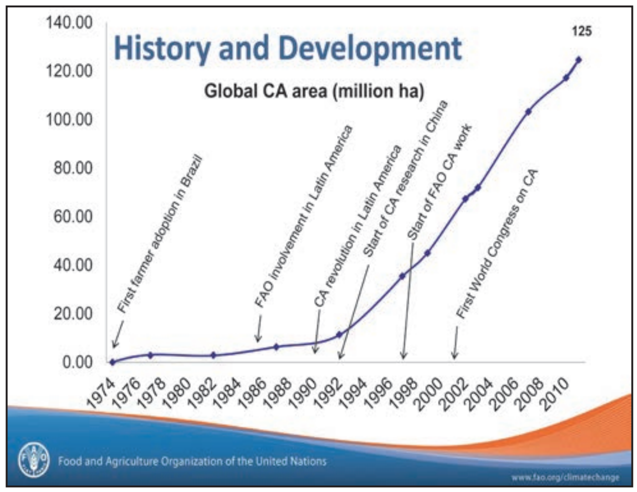

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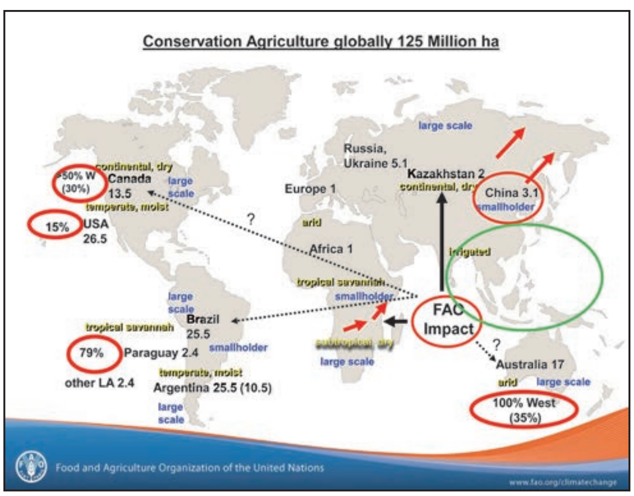

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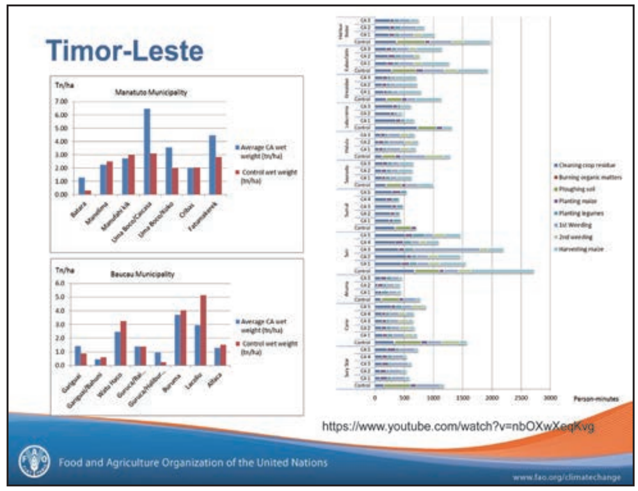

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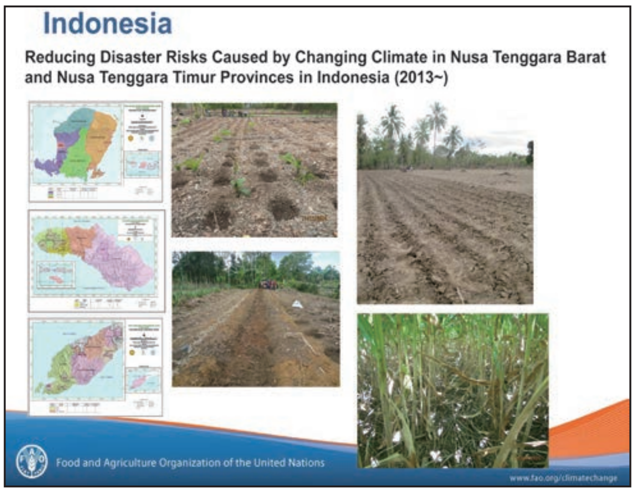

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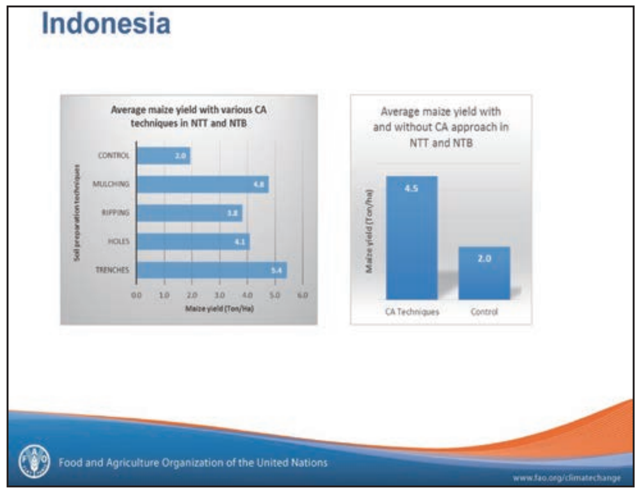

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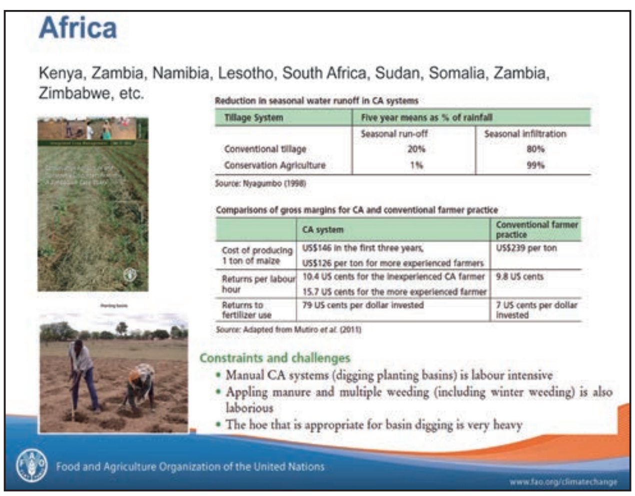

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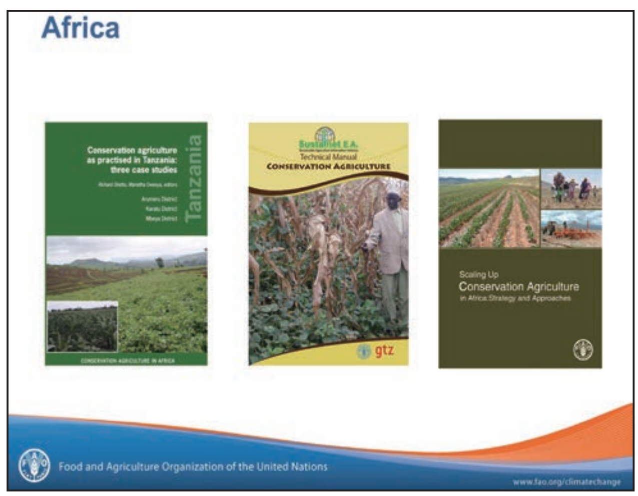

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History and Development

Issues around CA adoption and scaling:

- CA is a concept – no blueprint
- Local adaptation works best in a farmer discovery/ learning process – participation of private sector/ input suppliers is crucial for uptake
- CA works through synergy – hence all three components are important (to some degree)
- Understanding of the concept is important for practice solutions for CA – in some cases "gradual" approaches work, in others full adoption is better

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History and Development

Issues around CA adoption: Common perceptions

- No-till needs more herbicides: tillage conserves seeds; multiplies rhizomes; CA has non chemical options for weed management
- No-till soils compact: compaction comes from traffic; no-till CA soil with mulch compacts less; biological tillage/SOM to "repair";
- Residues vs. livestock: CA produces over time more biomass; better IC-LS options/double purpose cover crops
- Residues tie nitrogen: only when soil and straw is mixed
- Residues carry pests and diseases: they also host beneficial fauna and flora; crop rotation is key
- Root crops and CA: no problem for most; some adaptation in harvest or cultivation

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Action Areas for Scaling-up CA

- ❖ **increase investments in sustainable agricultural practices**
  - – public and private investment
  - – policies and regulations – land tenure over multiple seasons; market guarantees
- ❖ **enhance research, learning and knowledge sharing**
  - – identify practices and technologies affordable to small-scale farmers (limited income, market access, inputs)

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Action Areas for Scaling-up CA

- ❖ **diversify agricultural mechanization and improve access to inputs**
  - – regular supply of reduced-tillage equipment and seed stock for cover crops
  - – manufacture of CA equipment locally
  - – identify and market multifunctional seed stock
- ❖ **establish new market opportunities**
  - – niche and "green" markets
  - – establishing GAP or organic certification processes
  - – carbon sequestration compensation mechanisms

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Action Areas for Scaling-up CA

- ❖ **develop institutional framework and national roadmap**
- ❖ **Integrate and coordinate initiatives among policy-makers, financial institutions, private sector, administrators, research institutions, advisory and knowledge exchange bodies, with the farmers**
- ❖ **STRONG ADVOCACY!**

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Policy and Institutional Support for Conservation Agriculture in the Asia-Pacific Region

Conservation Agriculture Alliance for Asia and the Pacific (CAAAP) established

http://www.caa-ap.org/index.html

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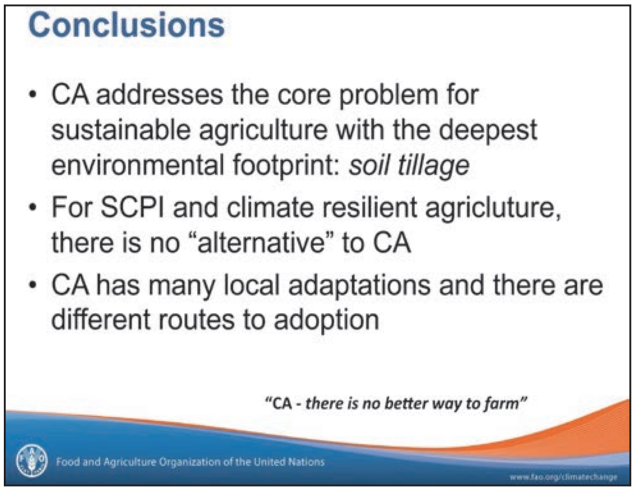
Conclusions
• CA addresses the core problem for sustainable agriculture with the deepest environmental footprint: *soil tillage*
• For SCPI and climate resilient agriculture, there is no "alternative" to CA
• CA has many local adaptations and there are different routes to adoption
"CA - there is no better way to farm"
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CA, the Agriculture of the Future – the Future of Agriculture
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