Perspectives and experiences on Conservation Agriculture for Sustainable Intensification in Southeast Asia

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A triple Challenge for agriculture

• More food, in quantity, quality and diversity, everywhere for everyone (availability, accessibility, utilisation, stability)

• Adapt to Climate Change

• Contribute to mitigate Climate Change

  – Agriculture and Land use = 30% of emissions
  – Needs to be part of the solution ...
Overlaps, Synergies and Trade-offs

Global Objectives
- Food Security
- Climate mitigation and adaptation
- Disaster Resilience
- Sustainable land management

Climate-smart agriculture: addressing multiple objectives
What means Climate-Smart Agriculture?

Transform agriculture to enhance the achievement of national food security and development goals in the light of global challenges

www.fao.org/climatechange/climatesmart
Towards climate-smart agricultural landscapes

Practices + Policies and institutions + Financing

No hedged landscaping:
- soil drying and destructuring, farming area aridity, significant evapotranspiration
  - Farming along slopes
  - Poorly controlled irrigation
  - No ground cover: leaching

- Decreasing water resources
  - Water flows rapidly over the surface taking the soil with it: erosion
    - (depleted area no longer suitable for farming) and silting-up shoals and rivers

Developing hedged landscaping:
- protecting the soil, maintaining moistures, renewing organic matter
  - Developing hedged landscaping
  - Grass strips and terraces
  - Crops following contour lines
  - Ground cover
  - Limting runoff, stabilizing soils, good water infiltration into the soil

- Renewing and storing water resources
  - Protecting soils and renewing fertility
  - Afforestation
<table>
<thead>
<tr>
<th>Agricultural Sector or Sub-sector and Practices</th>
<th>Adaptation</th>
<th>Mitigation</th>
<th>Climate smart agriculture</th>
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<tbody>
<tr>
<td><strong>Crop</strong></td>
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<tr>
<td>Conservation agriculture</td>
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<tr>
<td>Integrated pest management</td>
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<td>System for rice intensification</td>
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<td><strong>Livestock</strong></td>
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<td>Improved pasture management</td>
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<td>Afforestation, reforestation and forest restoration</td>
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<td><strong>Fishery</strong></td>
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<td>Decreased use of fish meal and fish oil feeds</td>
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<td>Reduce excessive fishing capacity</td>
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<td>Diversification of species</td>
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<td>Sustainable land management</td>
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<tr>
<td>Improve crop and grass land management</td>
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<tr>
<td>Restoration of degraded lands and organic soils</td>
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<td><strong>Water management</strong></td>
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<td>Irrigation modernization</td>
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<tr>
<td>Wet-and-dry irrigation in paddy fields</td>
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<td>Rainwater harvesting</td>
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<td><strong>Cross-sector</strong></td>
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<tr>
<td>Efficient energy use</td>
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<td>Reduced post-harvest losses and waste recycling</td>
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<tr>
<td>Disaster risk management</td>
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<td>Breeding of new crop, plant and animal varieties</td>
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Sustainable Crop Production Intensification

• Highest possible production
• Environmental footprint < recovery capacity
Technical objectives

- **Agricultural land productivity**
- **Natural capital and flow of ecosystems services** Simultaneously!
- **Enhanced input-use efficiency**
- **Use of biodiversity – natural and managed (and carbon) to build farming system resilience**
- **Contribute to multiple outcome objectives at farm, community & landscape scales – food and agriculture system**
- **Rehabilitation of degraded agricultural land and agro-ecosystems**

But how?
Soil & Ecosystem Health

Agriculture must, literally, *return to its roots* by rediscovering the importance of healthy soil, and rehabilitating its ecosystem services.

A healthy productive soil is a *living system* to be managed as a ‘complex’ biological system.

Mobilize the whole ecosystem rather than fight or degrade it, and enhance natural capital and the flow of ecosystem services.

No *single* solution but all solutions in agricultural lands need to be based on Conservation Agriculture principles and locally formulated practices.
3 Principles of ecological sustainability

Empirical and scientific evidence internationally shows ....

• No or minimum mechanical soil disturbance by – seeding or planting directly into untiiled soil

• Enhance and maintain organic matter cover on the soil surface – using crop residues and cover crops to protect & feed soil life

• Diversification of species -- both annuals and perennials - in associations, sequences and rotations

Conservation Agriculture, together with other good practices
Sustainable Land Preparation
Planting holes, ripping or mulching, direct drill
Once soil brought to good condition, avoid its unnecessary disturbance, and plant seeds through the mulch.
Residue retention distinguishes Conservation Agriculture from conventional farming systems, which are characterized by leaving the soil bare and unprotected, exposed to climatic agents.
Water infiltration, just after a thunderstorm
Gains in Rainfall Infiltration Rate with CA

Less flooding – improved water cycle

Benefits of CA

Landers 2007
COMPARISON

A FARMER’S TRIAL – CLODS OF TOPSOIL FROM ADJACENT PLOTS, PARANÁ, BRAZIL (Shaxson 2007)

PRO-BIOTIC ▲
Topsoil after 5 years with retention of crop residues and no-till seeding.

ANTI-BIOTIC ▲
Topsoil after regularly-repeated disk tillage, without retention of residues
Ecological Base of CA

- Organic agriculture
- Agroforestry - Landscape management

- Pollinator/Biodiversity management
- Good seed
  - Genetic potential
  - Genetic resources mgmt.

- Sustainable mechanization
- Compaction management, CTF
- Integrated Pest Management
- Permanent Bed and Furrow Systems
- System of Rice Intensification
- Integrated Weed Management

- Integrated Water management
- Integrated Plant Nutrient Management

- Minimum soil disturbance
- Soil Cover
- Crop Diversity

- Crop-Livestock integration

- Genetic potential
- Genetic resources mgmt.

- Integrated Plant Nutrient Management

- Organic agriculture
Conservation Agriculture

Drivers for adoption:

• **Erosion:** North America, Brazil, China

• **Drought:** China, Australia, Kazakhstan, Zambia

• **Cost of production:** global

• **Ecosystem services** global
Conservation Agriculture

Impacts:

- Increase of yields and production
- Less fertilizer use (-50%) less pesticides
- Less machinery and labour cost (-70%)
- Higher profit
- More stable yields – lower impact of climate (drought, floods, heat, cold)
- Lower environmental cost (water, infrastructure)
Documented benefits of CA for food security and environment

Small scale -- Paraguay, Tanzania, Lesotho, Zimbabwe

Large scale -- Canada, Brazil, Australia, Argentina .....
Global CA area (million ha) over time

History and Development
## CA area in Asia over time

Extent of CA adoption (‘000 ha) in Asia in 2008/09, 2013/14 and 2015/16

<table>
<thead>
<tr>
<th>Country</th>
<th>CA area 2008/09</th>
<th>CA area 2013/14</th>
<th>CA area 2015/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1,330.00</td>
<td>6,670.00</td>
<td>9,000.00</td>
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<tr>
<td>Kazakhstan</td>
<td>1,300.00</td>
<td>2,000.00</td>
<td>2,500.00</td>
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<tr>
<td>India</td>
<td></td>
<td>1,500.00</td>
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<tr>
<td>Kyrgyzstan</td>
<td></td>
<td>0.70</td>
<td>50.00</td>
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<tr>
<td>Turkey</td>
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<td>45.00</td>
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<tr>
<td>Syria</td>
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<td>30.00</td>
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<tr>
<td>Korea, DPR</td>
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<td>23.00</td>
<td>23.00#</td>
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<tr>
<td>Iraq</td>
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<td>15.00</td>
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<tr>
<td>Uzbekistan</td>
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<td>2.45</td>
<td>10.00</td>
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<tr>
<td>Azerbaijan</td>
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<td>1.30</td>
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<tr>
<td>Lebanon</td>
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<td>1.20</td>
<td>1.20#</td>
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<tr>
<td>Pakistan</td>
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<td>600.00</td>
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<tr>
<td>Iran</td>
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<td>150.00</td>
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<tr>
<td>Bangladesh</td>
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<td>1.50</td>
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<td>Tajikistan</td>
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<td>1.20</td>
</tr>
<tr>
<td>Vietnam</td>
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<td></td>
<td>1.00</td>
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<tr>
<td>Cambodia</td>
<td></td>
<td></td>
<td>0.50</td>
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<tr>
<td>Laos</td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2630.00</strong></td>
<td><strong>10,288.65</strong></td>
<td><strong>13,930.20</strong></td>
</tr>
<tr>
<td><strong>% difference</strong></td>
<td><strong>291.2 since 2008/09</strong></td>
<td><strong>429.7 since 2008/09</strong></td>
<td><strong>35.4 since 2013/14</strong></td>
</tr>
</tbody>
</table>

# from 2013/14.
Experiences in Asia:

• China promotes CA officially as means against drought, dust storms, erosion; subsidies for equipment
• Kazakhstan promotes CA in wheat growing areas in the North
• DPR Korea promotes CA to fight hunger
• Special challenge: convert paddy rice to CA
• India, Bangladesh und Pakistan experiment with components of CA
• Growing interest in CA in SE Asia (Cambodia, Laos)
Pakistan/India
Surface mulching with zero till – wheat, Pakistan
No-till in Kazakhstan

(Wall, 2008)
Kazakhstan

History and Adoption of CA
Experiences in China

机械播种，无耕作
in stubble left fields
No-till in China

Wheat No-tilled into maize stubble

Example #3

(McGarry, 2006)
CA for CC adaptation
CHINA: innovation with raised-bed, zero-till SRI field; measured yield 13.4 t/ha; Liu’s 2001 yield (16 t/ha) set provincial yield record and persuaded Prof. Yuan Longping
North Korea

History and Adoption of CA
Rice:
- no puddling
- no flooding
- less CH$_4$
- less N$_2$O
- less water
All crops can be seeded in No-till systems

Potatoes under No-till after rice in North Korea

(Friedrich, 2006)
Southeast Asia

Alternatives

• intensive commercial agricultural systems based on high chemical input
• solution to restore soil fertility and degraded environment (acidic or salty or polluted soils)
• erosion control both at plot and landscape levels
• Intensification and diversification of agriculture in mountainous areas
Timor-Leste https://vimeo.com/103779391

Lao PDR https://vimeo.com/117622628
Timor-Leste
Enhancing Food and Nutrition Security and Reducing Disaster Risk through the Promotion of Conservation Agriculture (2013~)

Timor-Leste

https://www.youtube.com/watch?v=nbOXwXeqKvg
Indonesia

Reducing Disaster Risks Caused by Changing Climate in Nusa Tenggara Barat and Nusa Tenggara Timur Provinces in Indonesia (2013~)
Indonesia

Average maize yield with various CA techniques in NTT and NTB

<table>
<thead>
<tr>
<th>Soil preparation techniques</th>
<th>Maize yield (Ton/Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL</td>
<td>2.0</td>
</tr>
<tr>
<td>MULCHING</td>
<td>4.8</td>
</tr>
<tr>
<td>RIPPING</td>
<td>3.8</td>
</tr>
<tr>
<td>HOLES</td>
<td>4.1</td>
</tr>
<tr>
<td>TRENCHES</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Average maize yield with and without CA approach in NTT and NTB

- CA Techniques: 4.5 Ton/Ha
- Control: 2.0 Ton/Ha
History and Development

**FAO’s role:** Support to member countries:

- **Policies and Institutions:**
  - policy support for upscaling CA; coherent policies (mechanization/CA, extension)
  - institutions, supporting infrastructure: education/training, science/technology, commercial infrastructure (input supply)

- **Field level:** farmer-groups/associations; proof of concept and field evidence with farmer learning processes (FFS, earthworm clubs...)

- **FAO DRR/M** uses CA as concept
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
Conclusions

• CA addresses the core problem for sustainable agriculture with the deepest environmental footprint: *soil tillage*

• For SCPI there is no “alternative” to CA

• CA has many local adaptations and there are different routes to adoption

• FAO therefore mainstream CA as approach to cropping
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)
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
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!
Sustainable Crop Production Intensification