Conservation Agriculture/No till
A Climate Smart Agriculture Solution: the Kazakhstan and Ukraine experiences

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Conservation Agriculture Definition

FAO definition:

1. Minimal Soil Disturbance/No Till: the tilled area must be less than 15 cm wide or 25% of the cropped area (whichever is lower)

2. Soil permanent cover: Ground cover must be more than 30%

3. Crop rotation: Rotation should ideally involve at least 3 different crops. However, monocropping is not an exclusion factor
CA/No till: a paradigm shift

Ploughing used to be essential to control weeds, but it causes soil erosion and consequent loss of fertility (with variations according to local conditions).

CA/NT increases soil organic matter with the following benefits:

- reduced soil erosion;
- improved soil structure;
- reduced leaching;
- increased water infiltration;
- earthworms proliferation which creates channels that foster root growth.

From Martial Bernoux, Institut de Recherche pour le Développement (IRD)
<table>
<thead>
<tr>
<th>Tillage</th>
<th>No tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil de-structured</td>
<td>Improved soil structure</td>
</tr>
<tr>
<td>High erosion</td>
<td>Less erosion</td>
</tr>
<tr>
<td>Low water holding capacity</td>
<td>Increased water holding capacity</td>
</tr>
<tr>
<td>High yields variability</td>
<td>High yields stability</td>
</tr>
<tr>
<td>Higher tillage costs and time</td>
<td>Decreased seed bed preparation costs and time</td>
</tr>
<tr>
<td>Low competitiveness</td>
<td>Improved competitiveness</td>
</tr>
<tr>
<td>Low C sequestration</td>
<td>Moderate C sequestration</td>
</tr>
<tr>
<td>High environmental impact</td>
<td>Decreasing environmental impact</td>
</tr>
</tbody>
</table>
CA Triple Win-Win

**Economic/Financial benefits**

- Increased profitability by reducing soil preparation costs
- Possibility to have two crops/catch crops (in warmer climates)
- Reduced soil erosion and its related costs

**Climate Change Adaptation**

- Improving rainfall efficiency and soil moisture storing
- Increased soil organic matter, biodiversity and fertility

**Climate Change Mitigation**

- Reduced green house gas emissions
CA/NT History

**History and Development**

Global CA area (million ha)

- First farmer adoption in Brazil (1974)
- FAO involvement in Latin America (1976)
- CA revolution in Latin America (1980)
- Start of FAO CA work (1982)
- First CA congress in Central Asia (1984)
- Increased global interest in CA (1986)
- First World Congress on CA (1988)

*European Regional Conference (ERC) 2012: “Save and Grow” and promotion of Conservation Agriculture Baku, Azerbaijan*
## Global Adoption of CA/No Till

### Conservation Agriculture area as % of cultivated area (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>Conservation Agriculture area (1000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States of America</td>
<td>26,500</td>
</tr>
<tr>
<td>Argentina</td>
<td>25,553</td>
</tr>
<tr>
<td>Brazil</td>
<td>25,502</td>
</tr>
<tr>
<td>Australia</td>
<td>17,000</td>
</tr>
<tr>
<td>Canada</td>
<td>13,481</td>
</tr>
<tr>
<td>Russia</td>
<td>4,500</td>
</tr>
<tr>
<td><strong>China</strong></td>
<td>3,100</td>
</tr>
<tr>
<td>Paraguay</td>
<td>2,400</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>1,850</td>
</tr>
<tr>
<td>Bolivia</td>
<td>706</td>
</tr>
<tr>
<td>Uruguay</td>
<td>655</td>
</tr>
<tr>
<td>Spain</td>
<td>650</td>
</tr>
<tr>
<td>Ukraine</td>
<td>600</td>
</tr>
<tr>
<td>South Africa</td>
<td>368</td>
</tr>
<tr>
<td>Venezuela</td>
<td>300</td>
</tr>
<tr>
<td>France</td>
<td>200</td>
</tr>
<tr>
<td><strong>Zambia</strong></td>
<td>200</td>
</tr>
<tr>
<td>Chile</td>
<td>180</td>
</tr>
<tr>
<td>New Zealand</td>
<td>162</td>
</tr>
<tr>
<td>Finland</td>
<td>160</td>
</tr>
<tr>
<td>TOTAL</td>
<td><strong>124,067</strong></td>
</tr>
<tr>
<td>Others</td>
<td>1,000</td>
</tr>
</tbody>
</table>

**TOTAL**

**124,067**
Global Adoption of CA/No Till

Global adoption in 2010: ~125 Million ha (9% of arable land)

From Martial Bernoux (IRD) on data from Derpsch and Friedrich (FAO), and *Roberts and Johnston, 2009.
Produção de grãos no Brasil

*Milhões t*

1991: 57.8
1992: 68.2
1993: 68.3
1994: 76
1995: 81.2
1996: 73.8
1997: 78.9
1998: 76.5
1999: 82.4
2000: 100.3
2001: 97.1
2002: 115.2
2003: 125
2004: Conab

*Milhões ha*

1991: 37.8
1992: 38.4
1993: 35.6
1994: 39
1995: 38.4
1996: 36.8
1997: 36.4
1998: 35
1999: 36.7
2000: 37.7
2001: 37.5
2002: 39.7
2003: 41
2004: 42

Conab
Obstacles to Adoption

- Significant investments required to update farm machinery
- More evident and durable benefits when technology is applied for several continued years (issue when land tenure is insecure)
- Challenging technological changes & steep learning curve
- New weed management approach & increased herbicides cost (at least initially)
- Difficulty to handle crop residues, which cannot be used for animal feed or fuel
- Psychological and cultural bias

Adoption is easier in larger farms, and more challenging (but not impossible nor less beneficial) in smaller farms. That is why adoption takes time
The “S” curve of Technology Adoption

Kazakhstan

Argentina

Brazil
China must be in the forefront of promoting intensified sustainable agricultural practices since it only has 7% of global arable land but 22% of the global population. Conservation agriculture is an opportunity to increase sustainable development of agriculture in China now and in the future.

Professor Li Hongwen, lead CA expert in China Agriculture University

China’s recipe:
- High-level championship and ownership
- R&D (on machinery, cropping patterns, etc.)
- Widespread demonstrations/awareness raising
- Enabling policies and targeted subsidies
- Good governance

“Adoption is easier in larger farms, and more challenging (but not impossible nor less beneficial) in smaller farms. That is why adoption takes time.”
The Kazakhstan Experience:
TCI Implementation Support to the WB-ACP
Kazakhstan is a major wheat exporter
Kazakhstan cereals exports and their destinations (2012)

Total export 7.3 Mln MT
RUK is challenging the US as the largest wheat exporter in the world (global food security factor)

Wheat Production (1000 MT) vs. Wheat Export (1000 MT)

- United States
- RUK
Wheat is produced mostly in the northern part of Kazakhstan. Ranks the 9th place in the area extent. Around 20 mln ha is used for crop production, mainly for wheat – 14 mln ha. Mostly spring wheat, planted in spring and harvested in autumn because winters are too cold.
Rainfed wheat with limited precipitation
The importance of stubble

- 50% of yield depends on soil moisture
- Snow 30-40% of all precipitations
- Snow is taken away by the strong wind of the steppe or through runoff (causing erosion)
- Stubbles of preceding crop trap snow
- Snow melts more gradually and more water becomes available to growing crop
- The higher the stubble the better (35 to 40-45 cm for best results)

(LL from Saskatchewan, Canada)
Snow trapping
CA/NT Adoption in Kazakhstan

- Kazakhstan together with Russia has the highest adoption in ECA
- The area has grown more than 200% during the last 5 years
- Now it is practiced on at least 1.85 million ha (CIMMYT, 2012 based on rigorous latest assessment)
- The country is ranked 9th in the world for adoption
Progress of No-till Area in Kazakhstan

- CA/NT area in Kazakhstan
- 000 Hectares
- ACP END


- FAO TCP
- ACP START
- 50
- 100
- 600
- 1220
- 1440
- 1850
In terms of speed of adoption, during the last three years, Kazakhstan shares the 1st position with China.
A good business for farmers

Graph 2: Financial Benefits of Conservation Agriculture in Wheat Production in Northern Kazakhstan (F-IRR = 28%)
Kazakhstan - 2012 Incremental Estimates

- Wheat production was **10.7 million tons**
- Wheat no-till area has produced an estimated **1.8 million tons** of wheat
- **Incremental** wheat production only because of no-till area is about **0.7 million tons**, equivalent to around **220 million dollars**

Kazakhstan - Yield Increases

Wheat Productivity

- Traditional technology (t/ha)
- No till technology (t/ha)
National Benefits from CA/NT Adoption - Wheat only

Thousand ton

US$ million

Percent of Total Production

Million People Fed
Kazakhstan - Impact of CA/NT

• Increased income and food security during the last three years:
  – An estimated **580 million dollars** incremental income;
  – satisfied cereals requirements of about **5 million people annually**

• Climate Change mitigation: Kazakhstan contributes to the annual sequestration of about **1.3 million tons of CO₂** equivalent to the emissions of 270,000 cars
The Agricultural Competitiveness Project (ACP)

• 42 out of 585 Competitive Grants awarded for no-till/minimum tillage activities.

• Beneficiary farmers have expanded the technology to the rest of their farm areas (about 45,000 ha)

• Extension activities of KazAgroInnovation contributed to further expansion through seminars in knowledge centers, direct consultancies and call centers. High demand topic
ACP Contribution

- Due to replication effect, extrapolation can be made for the entire country which would allow the assumption that some **350,000-400,000** ha of NT area have been promoted thanks to ACP
- Strengthened links between research centers and farmers reduced failures
- ACP supported the CIMMYT assessment
Kazakhstan – CA/NT State of art and needs

- **GOK** and the national research system have done a lot: policy, incentives, investment, R&D
- The private sector has invested (specifically) over **200 million dollars**
- CA/NT specialized machinery companies are expanding, but farmers depend excessively on machinery suppliers
- Some farmers reversed adoption because of organizational challenges
- To enable further expansion and avoid reversals more investment is required
- More farm/business specific R&D, Knowledge Dissemination, and expert advice
The Ukraine Experience:
Study on Potential Benefits of CA/No till Adoption in Ukraine
Ukraine cereals exports and their destination (2012) - State Customs Committee of the Ukraine, Global Trade Atlas

Total Export 27.1 mln MT

- Egypt 20.5%
- Spain 15.3%
- Saudi Arabia 6.9%
- Iran 6.5%
- Israel 6.0%
- Korea, South 3.9%
- Italy 3.7%
- Portugal 3.5%
- Japan 3.3%
- Libya 3.2%
- Others
Erosion in Ukraine is a major issue

• The country is gifted by nature with a strategic production asset: the Chernozems

• These soils over the years have been widely degraded by erosion

• Erosion is causing every year a loss of soil fertility currently valued at US$5 billion, which is 1/3 of Ag. GDP

• 10 tons of soil eroded per ton of grain produced!!
Erosion: the Steppe example
Interlinked issues

• **Comparative advantage** of crop production systems in Ukraine is threatened:
  – Output *volatility and high costs* of production

• **Competitiveness** is at risk (agricultural enterprises contribute over 85 percent to the *agricultural GDP*)

• Siltation of rivers, harbors, and dams (feeding hydroelectric power stations water intakes): *not quantified* yet.

* 13.7 billion USD
Interlinked issues

Winter and Spring Wheat yield dynamics (Dnepropetrovsk, Steppe)

Soil Moisture in Ukraine with respect to 1971-2000 mean
Drivers and halters

• Land tillage is the major driver of soil erosion

• Climate Change will further exacerbate all phenomena (crop yield related studies are required)

• Land tenure insecurity

• Biases: soil quality, yields and knowledge (soils, CC)
Actions: current

• MAPF advocates resource saving technologies
• Academics continue their analyses
• Farmers have moved decisively to Minimum Tillage (estimated on over 20 million ha).

An important step forward but not effective in a sustainable manner: soil degradation will continue

• Few sparse progressive farmers exist: CA is applied on 600-700 thd ha, mainly in Steppe
Actions: future

• CA/ No till:
  – contrasts erosion, maintains soil fertility, and enhances drought resilience (evidence-based)
  – abates costs of production by minimizing fuel consumption (evidence-based)

• Growing interest among academics and enterprises in Ukraine
Technology comparison effects

**Fuel consumption**

- No-till: 30 l/ha
- Mini-till: 60 l/ha
- Conv. tillage: 100 l/ha

**Soil losses**

- No-till: 3 t/ha
- Mini-till: 4.5 t/ha
- Conv. tillage: 6 t/ha

**Expected yield decrease during unfavorable years**

- Conv. tillage: -25%
- Mini till: -25%
- No till: -19%
### Scenarios (by priority)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short term (3-5y):</strong></td>
<td>all larger enterprises in Steppe (&gt; 4000 ha)</td>
<td>3 million ha</td>
</tr>
<tr>
<td><strong>Medium term (6-10y):</strong></td>
<td>all enterprise managed area in Steppe</td>
<td>9 million ha</td>
</tr>
<tr>
<td><strong>Long term:</strong></td>
<td>all enterprise managed area in all AEZ</td>
<td>17 million ha</td>
</tr>
</tbody>
</table>
Potential benefits: farm level

NPV (thd USD)

- Conventional: 4.723
- Min. Tillage: 5.523
- No-till: 6.685

Net Income per HA (USD)

- Conventional: 219
- Min. Tillage: 282
- No-till: 387

Farm level additional net income, in bln USD

- 3 million hectares: 0.41
- 9 million hectares: 1.23
- 17 million hectares: 2.31
Potential benefits: global level

Additional people fed, mln persons

<table>
<thead>
<tr>
<th></th>
<th>3 milion hectares</th>
<th>9 milion hectares</th>
<th>17 milion hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.4</td>
<td>16.1</td>
<td>30.4</td>
</tr>
</tbody>
</table>

C sequestration in million tons CO₂ (climatic options average)

<table>
<thead>
<tr>
<th></th>
<th>Past</th>
<th>Future</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.2</td>
<td>1.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Adoption scenario</td>
<td>2.2</td>
<td>3.3</td>
<td>31.1</td>
</tr>
<tr>
<td>Average benefits</td>
<td>0</td>
<td>1.9</td>
<td>28</td>
</tr>
</tbody>
</table>

Reduced fuel burning emissions in CO₂ million tons

<table>
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<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced fuel burning emissions</td>
<td>0.2</td>
<td>1.8</td>
<td>2.3</td>
<td>45.7</td>
</tr>
</tbody>
</table>
CA technology adoption in Ukraine would provide important benefits

<table>
<thead>
<tr>
<th>Aggregated Benefits at Different Levels (monetary and non)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level</strong></td>
</tr>
<tr>
<td>Farm/Enterprise</td>
</tr>
<tr>
<td>National</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total (annual)</td>
</tr>
<tr>
<td>Global</td>
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</tbody>
</table>
Check these media


http://www.youtube.com/watch?v=q1aR5OLgcc0

Thank you for your attention