

**International Seminar on Enhancing Extension of Conservation Agriculture Techniques  
in Asia and the Pacific (Zhengzhou, China, 24 – 26 October 2007)**

# **Degradation of natural resources and measures for mitigation**

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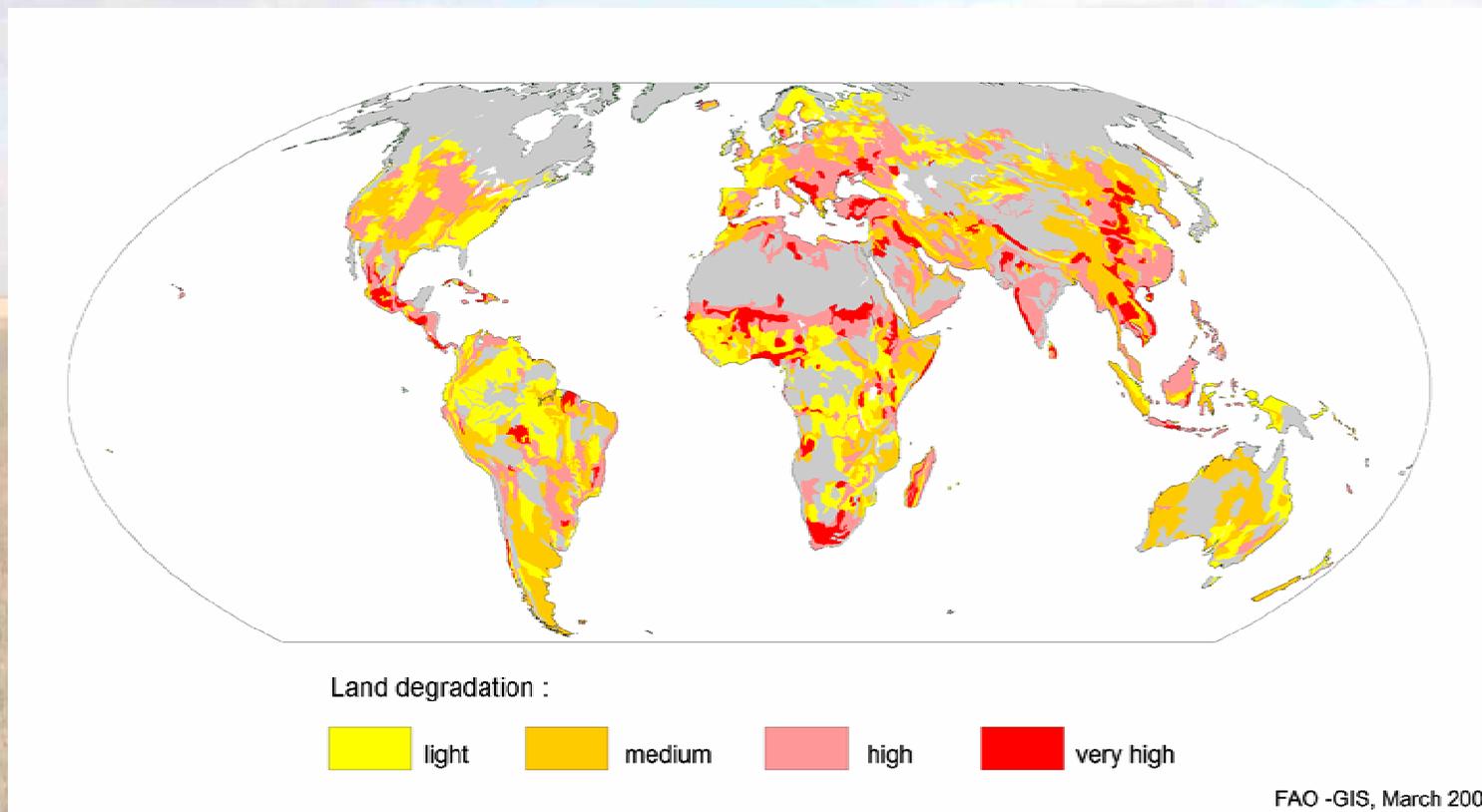


**Food and Agriculture Organization of the United Nations**

- **Background**
- **Resource conserving practices**
- **Effect of Conservation Agriculture**
- **Conclusions**

- Food production until 2030 has to double
- Increasing demand for bioenergy and renewable resources
- Growth in crop production below population growth
- New land limited (including irrigated land)
- >50% of available water resources already used for irrigation
- Major changes needed to attain the MDGs (higher productivity, less resource degradation)
- Climate change: additional threat

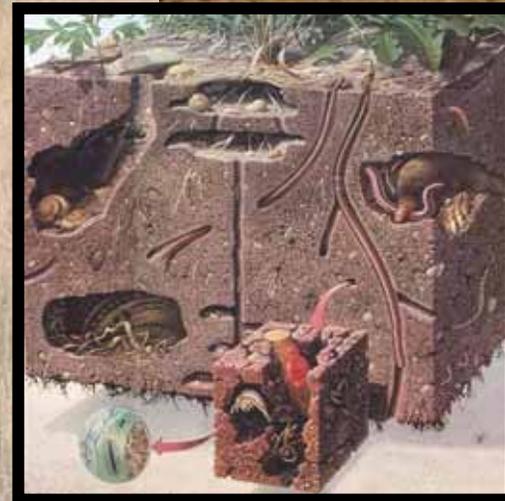
# Degradation of soil resources: All agricultural soils show signs of degradation



**World map of severity of land degradation – GLASOD (FAO 2000)**

## Degradation of soil resources:

- Soil impacts on production, and on other resources like water
- Cultivated soils have lost considerable carbon
- SOM-levels below 2% are common
- Effects are worse in the tropics
- Tillage is a major soil degrading factor



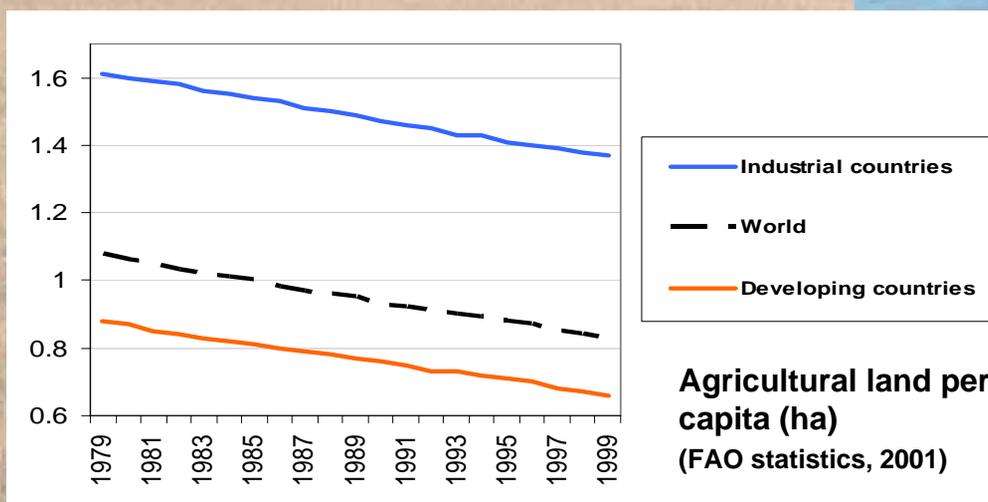
## Degradation of water resources:

- In 2025 the water consumption will exceed the available „blue water“
- 70% of actual water use is for agriculture
- Falling groundwater tables are common
- Drought periods and floods are increasing
- Increased temperatures and more erratic rainfall will affect rainfed agriculture



## Degradation of land resources:

- In Asia 90% of potential land is already used
- 1.3 Million ha of agricultural land are lost every year (urbanization)
- Available land per person is declining



## Degradation of biodiversity:

- Reduced biodiversity resulting from high yielding varieties, monocultures, intensive use of agrochemicals and tillage
- Increased vulnerability of cropping systems
- Reduced efficiency and profitability of input use



# Climate and Climate Change

- extreme precipitation
- extended drought periods
- agriculture is directly affected by CC
- agriculture handles 40% of land
- agriculture is contributing to CC
- agriculture can mitigate and adapt to CC



- Many resource conserving practices known
- Practices very old, revived in modern agriculture with mechanization (0-till)
- Mostly addressing soil and water conservation
- In isolation all have beneficial effects and downsides

## Examples of resource conservation practices:

- Conservation tillage (soil)
- Zero tillage (soil, water, fuel, time, )
- Terracing, contour lines (soil)
- Direct seeding (water, time)
- Green manure cover crops/mulch (soil, water)
- Controlled traffic farming (fuel, time)
- Drip irrigation (water)
- Laser levelling (water)
- Bed planting (water)

- Synergy effects between resource conserving technologies enforce benefits and eliminate downsides
- Synergy effects of zero tillage cropping systems described in modern agriculture in the 1940 (Faulkner and Fukuoka).
- Application of this cropping system in practice started in the 1970s in Brazil leading to a sustainable agriculture revolution

The combination of

- **Continuous zero tillage**
- **Permanent soil cover and**
- **Crop rotations**

has become known as

**Conservation Agriculture**



**Conservation Agriculture** is a a concept for *resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment. CA is based on enhancing natural biological processes above and below the ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and the use of external inputs such as agrochemicals and nutrients of mineral or organic origin are applied at an optimum level and in a way and quantity that does not interfere with, or disrupt, the biological processes. CA is characterized by three principles which are linked to each other (FAO)*

# Conservation Agriculture



Soil Organic Matter = Drought Resistance

Action of Soil Biota

High Soil Organic Matter

Zero Tillage

Conventional Agriculture

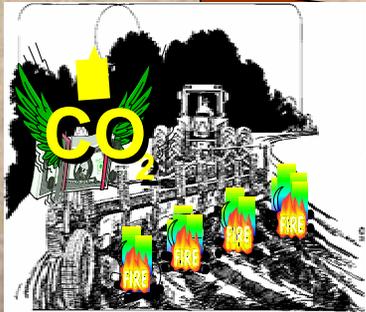


low soil organic matter

Biological Tillage



Mechanical Tillage



Additional resource conserving practices, as

- Direct seeding (rice)
- Bed planting
- Controlled traffic farming
- Laser levelling
- and others

combined with CA for additional synergies

# Specific techniques for CA: invisible seeding

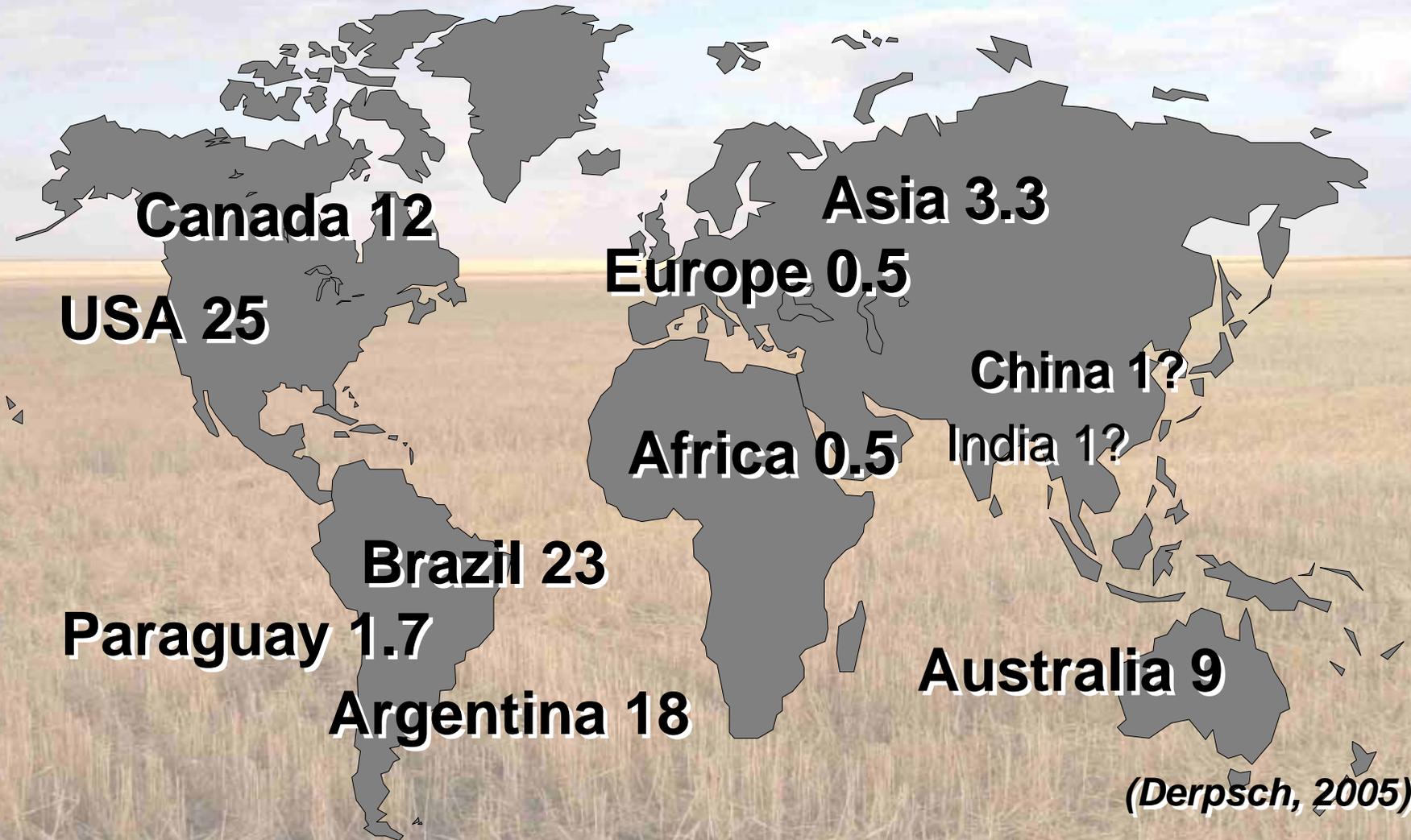
- Less weeds
- Less moisture loss



# Specific techniques for CA: controlled traffic farming



**Total area under Conservation Agriculture**  
**worldwide 95 Million ha**





Pakistan/India



USA



Kenya



Uzbekistan



Brazil



Nicaragua



Kazakhstan



North Korea



China

## **effect of CA on soil:**

- **CA adds up to 1 mm soil per year**
- **organic matter increase at about 0.1-0.2% per year until reaching a saturation**
- **different rooting systems for more efficient use of soil nutrients**
- **soil structure more stable**
- **erosion and degradation stopped/reversed**



## effect of CA on water:

- recharge of aquifer (permanent macropore structure in soil)
- improved water quality (less leaching and erosion)
- more available water in soils  
(1 % OM = 150 m<sup>3</sup>/ha)
- reduced water losses (evaporation), better water efficiency (requirements -30%)



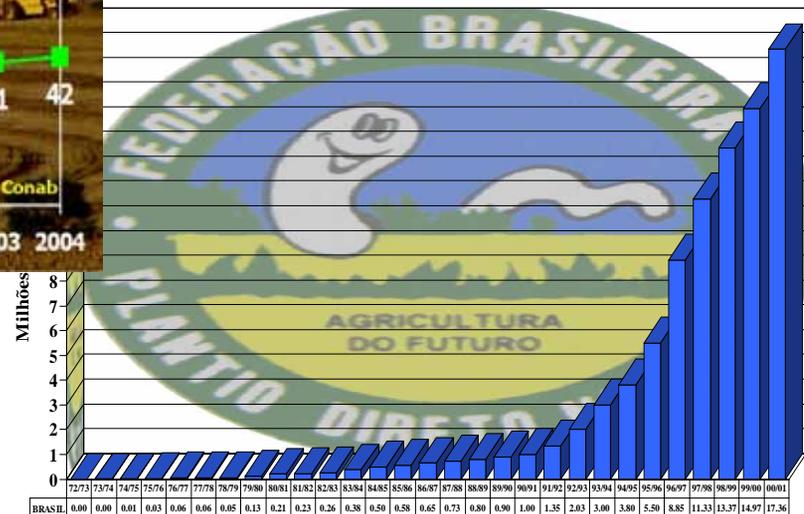
## **CA and climate change:**

- **mitigation through emission reductions (fuel, NO<sub>x</sub>, CH<sub>4</sub>)**
- **mitigation through carbon sequestration up to 0.2 t·ha<sup>-1</sup>·y<sup>-1</sup> C**
- **adaptation through better drought tolerance**
- **adaptation through better water infiltration (less flooding)**

# Production increase

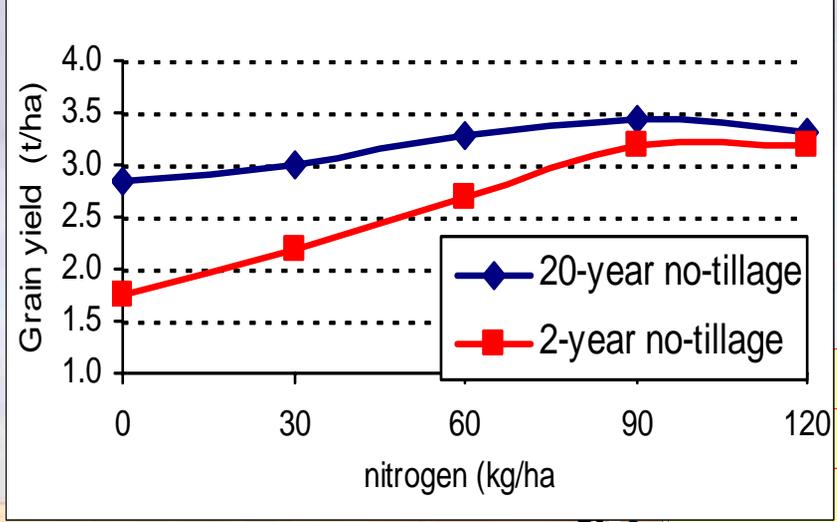


BRASIL - EXPANSÃO DA ÁREA CULTIVADA EM PLANTIO DIRETO  
SAFRA VERÃO/SAFRINHA/INVERNO

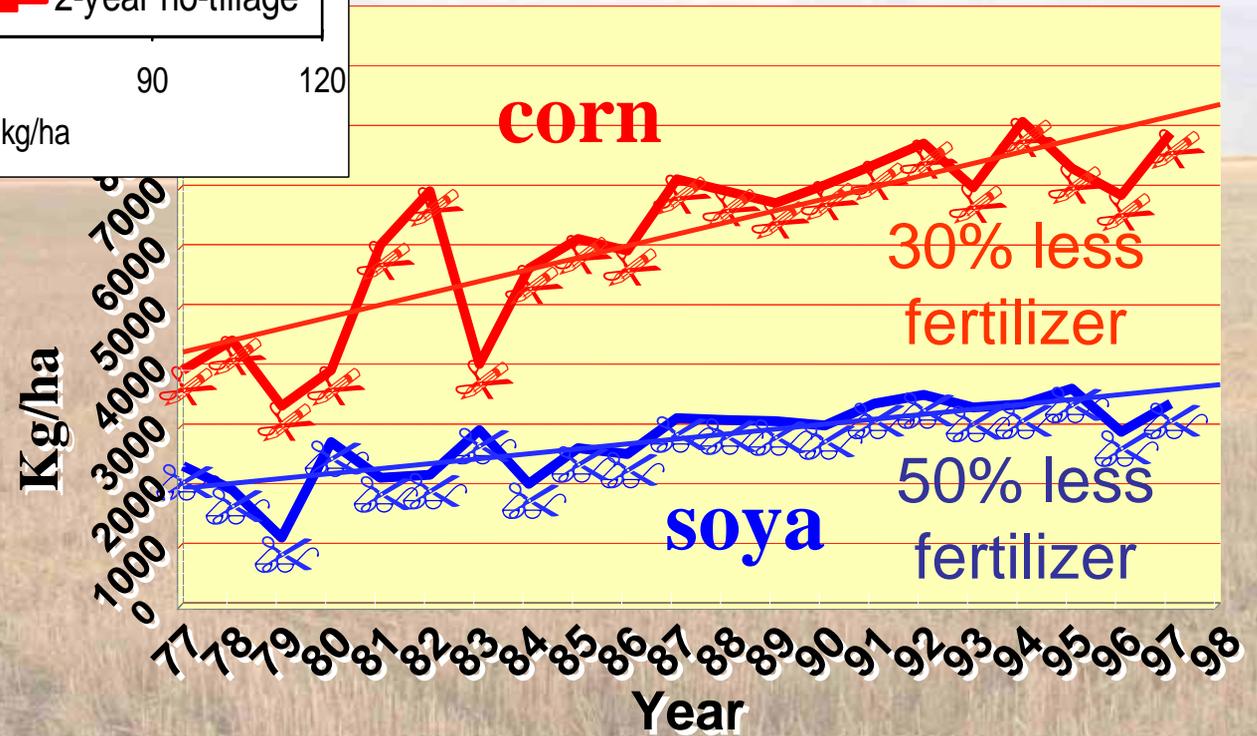


fonte: EMATER RS, EPAGRI/SC, EMATER-PR, CATI-SP, FUNDAÇÃO MS, APDC(CERRADO)

Wheat yield and nitrogen amount for different duration of no-tillage in Canada 2002 (Lafond 2003)



# Reduced fertilizer needs



Frank Dijkstra Farm, Ponta Grossa, Brazil, 1998

## Advantages for the farm:

- **50% saving in machine capital (tractors)**
- **3-fold lifetime of tractors**
- **40% smaller tractors**
- **50% labour saving**
- **70% fuel saving**



## For the farm family:

- Time for other tasks and for relaxing
- Better income and less stress



## For communities:

- **Less pesticide use (-20%), less pollution**
- **Lower cost for water treatment**
- **More stable river flows**
- **Lower road/waterway maintenance**



## Global:

- Groundwater resources
- Soil resources
- Biodiversity



- **Need for global production increase**
- **Natural resources base to be enhanced**
- **Sustainable production combining resource conserving practices**
- **Climate change to be addressed**
- **Conservation agriculture best option for intensive sustainable production**

A landscape photograph showing rolling hills and fields under a blue sky with scattered white clouds. The foreground is dominated by a field of golden-brown grass. In the middle ground, there are several green and yellow fields, some of which are separated by narrow paths or ditches. In the background, there are more hills and a few trees, including a prominent palm tree on the left side.

**The future is in YOUR hands!**

**Thank you for your attention!**

More information:

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**<http://www.fao.org/ag/ca>**