Climate Change and Mitigation in Agriculture in Latin America and the Caribbean: Investments an Actions, FAO and World Bank, Rome 19-20 April 2010

Agricultural Mitigation Strategies

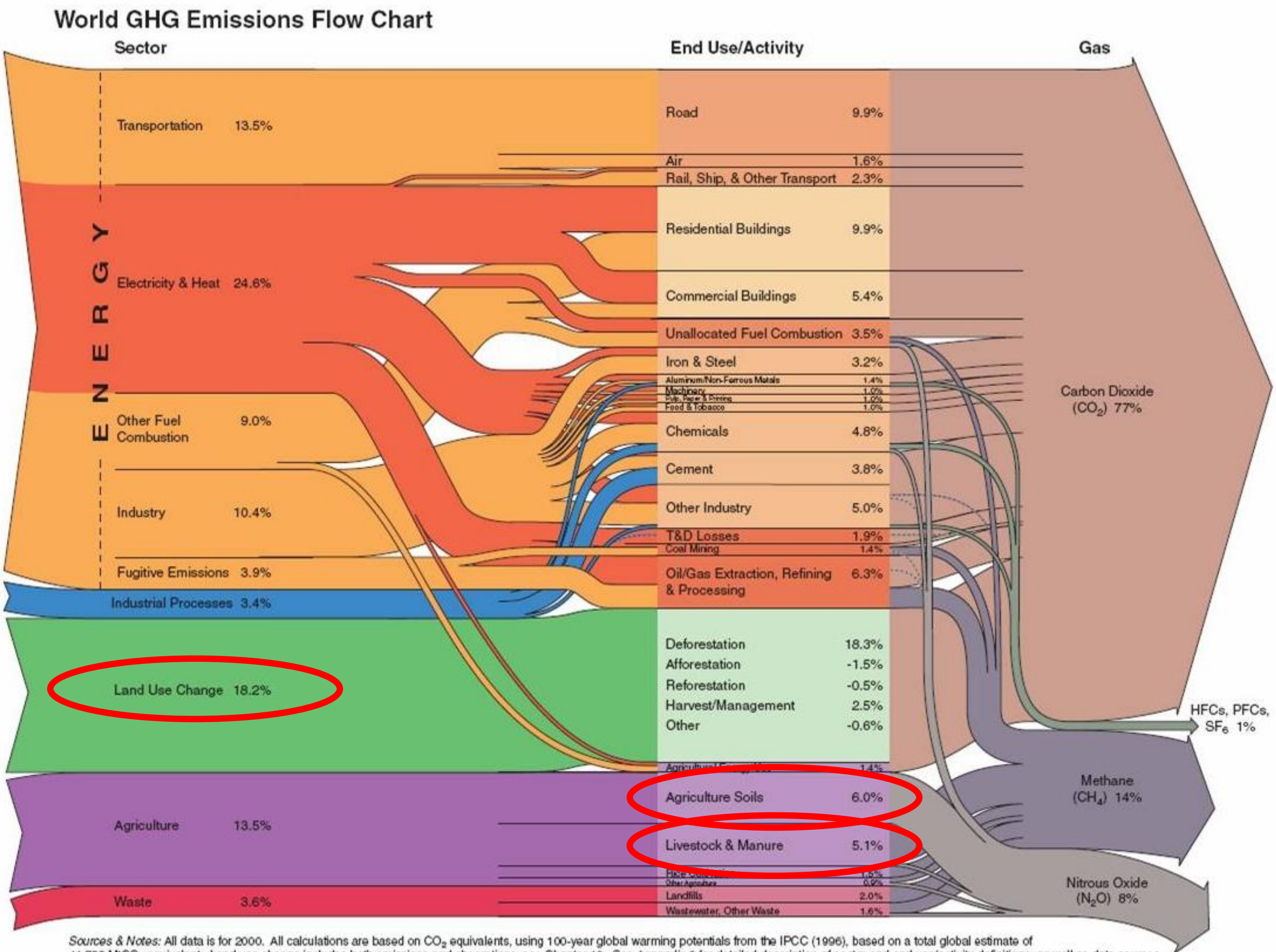
technical information and recommendations

Theodor Friedrich
Senior Officer AGP

Food and Agriculture Organization of the United Nations

- Agriculture as driver
- Global potentials
- Mitigation strategies
- Mitigation potential
- Conclusions

agriculture as driver



Sources & Notes: All data is for 2000. All calculations are based on CO_2 equivalents, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 41,755 $MtCO_2$ equivalent. Land use change includes both emissions and absorptions; see Chapter 16. See Appendix 2 for detailed description of sector and end use/activity definitions, as well as data sources. Dotted lines represent flows of less than 0.1% percent of total GHG emissions.

Greenhouse gas emissions:

- Carbon Dioxide is the most important GHG
- Other GHG (Methane, Nitrous Oxide) more powerful
- Still 77% of total GHG in CO_2 equivalent is due to CO_2
- Agricultural land use contributes 32% of all GHG:
    - about 25% of all CO_2
    - about 60% of all CH_4 and N_2O
- The major largest components are:
    - Land use change: 18.3%
    - Nitrogen emissions from agricultural soils: 6%
    - Methane from livestock & manure: 5%

Agriculture mitigating climate change

- Globally 5 bill ha ($5 \cdot 10^9$) under all agriculture i.e. managed by mankind (= 40% of total land)
- of this 1.4 bill ha are cropland
- Significant impact on climate change

Agriculture mitigating climate change

- Global pool of Soil Organic Carbon 1,500 Pg (1 Pg = 1 bill. metric tons = 1 Gt)
- Agriculture has released 456 Pg C from SOC which builds the potential for soil as C-sink
- Potential C-capturing from cropland: 0.75 – 1.0 bill t (Pg)/year
- Total potential for increasing the terrestrial C pool is about 3 Pg/year = about the annual increase in global CO_2 concentration
- Additionally emission reductions possible

Agricultural (crop) mitigation strategies:

- **Sequestration:**
  Maximize soil as carbon sink
  - reduce soil carbon emissions
  - maximise biomass production
  - enhance soil carbon input
- **Emission reduction:**
  - Rice – methane
  - Fertilizer – nitrous oxide
  - Fuel emissions
  - Emissions from input manufacturing
  - Manure handling
  - Bio energy?

Sequestration:

Carbon Offset Consultation at CTIC, West Lafayette, October 2008:

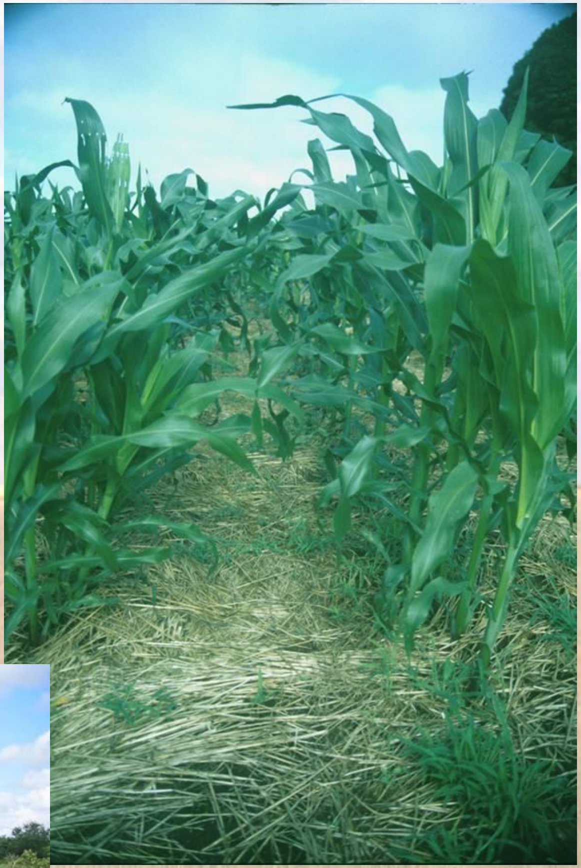
- **CA base for carbon credit protocols**
- **CA for CC mitigation and adaptation**
- **CA technologies for Climate Change adaptation and mitigation available**

The **simultaneous** combination of

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

has become known as

Conservation Agriculture



Conservation Agriculture

Soil Organic Matter = Drought Resistance

Conventional Agriculture

Action of Soil Biota

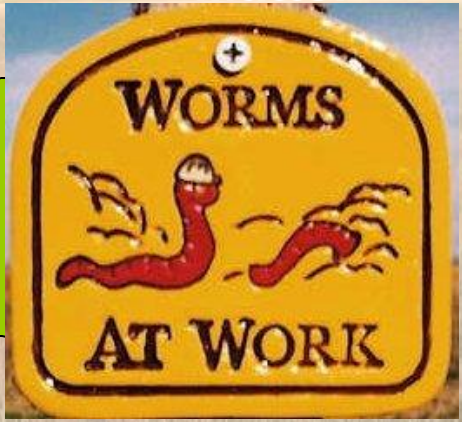
Structure/Porosity

low soil organic matter

High Soil Organic Matter

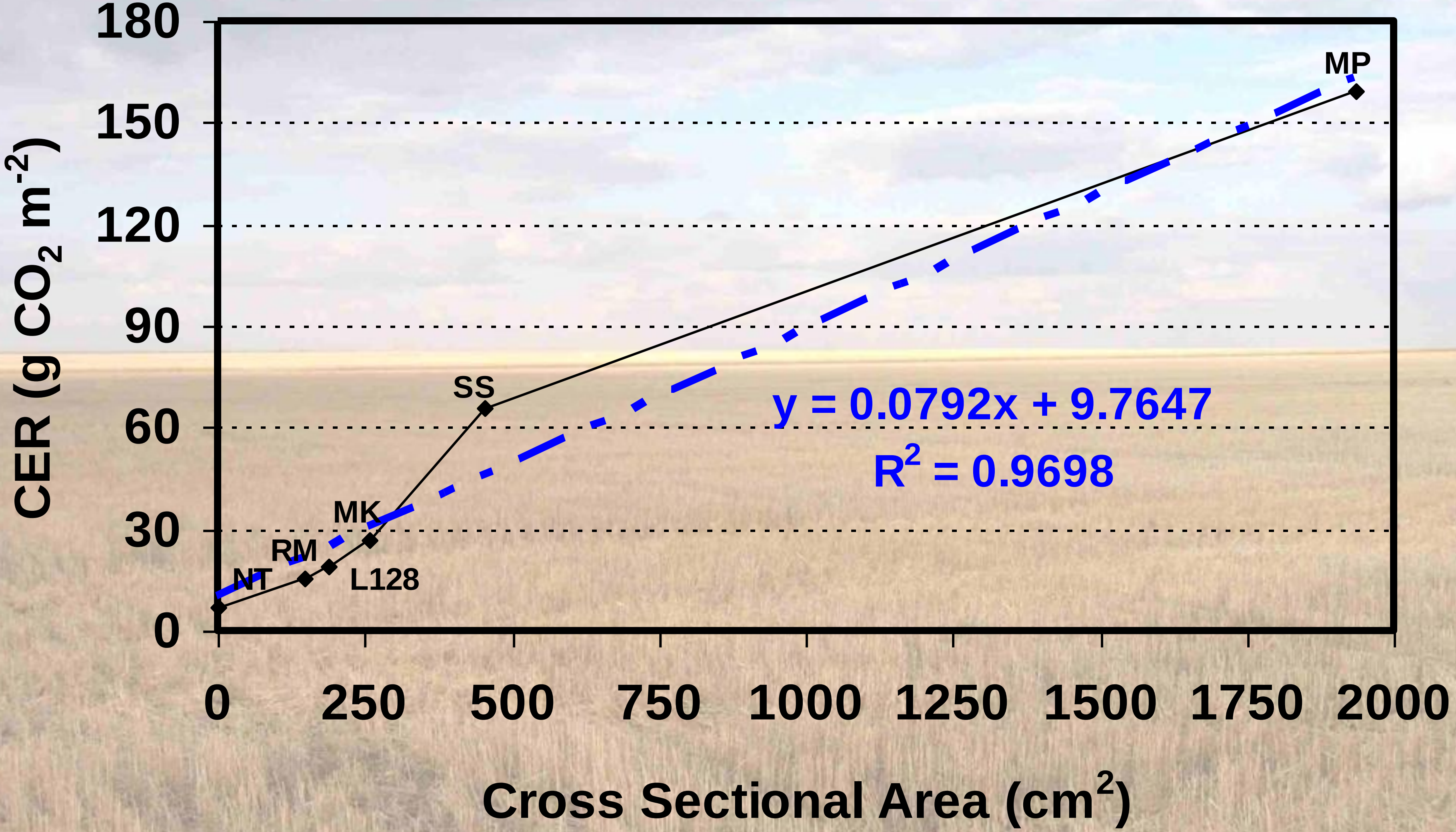
Zero Tillage

Biological Tillage



Mechanical Tillage

Cumulative Carbon Dioxide Loss after 24 hours



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CA and climate change:

- **No single practice safely qualifies for carbon credits (no-till, compost, organic)**
- **No-till a necessary, not sufficient condition for Carbon Sequestration in most climates**
- **Protocols for optimized systems to be established**
- **Attention to lifecycles and other GHG (compaction, irrigation)**

Emission reductions: Rice – CH_4 ++

- CA-rice: no-till/no puddling
- Residue retention
- no permanent flooding
- evtl. permanent beds
- SRI agronomy for better root development & productivity

Emission reductions: N-Fertilizer

- Use of legumes in rotation
- Careful use of N fertilizer
- Placement of N fertilizer (urea)
- Irrigation (no flooding)
- Compaction: CTF

Emission reductions:

- Fuel emissions
- Emissions from input manufacturing: biological processes replacing functions of
  - machinery
  - fertilizer
  - pesticides
- Manure handling:
  - biogas
  - aerobic composting
  - application into cover crops/crop residues
  - knifing into soil (small quantities)
- No burning – avoidance of fire

Bio energy:

- Bio energy = low efficiency solar energy
- Carbon: either for bio energy or for carbon sequestration
- Carbon in soils has other beneficial effects beyond carbon sequestration
- Diversion of carbon towards bio energy reduces the speed of soil carbon build up

Biochar:

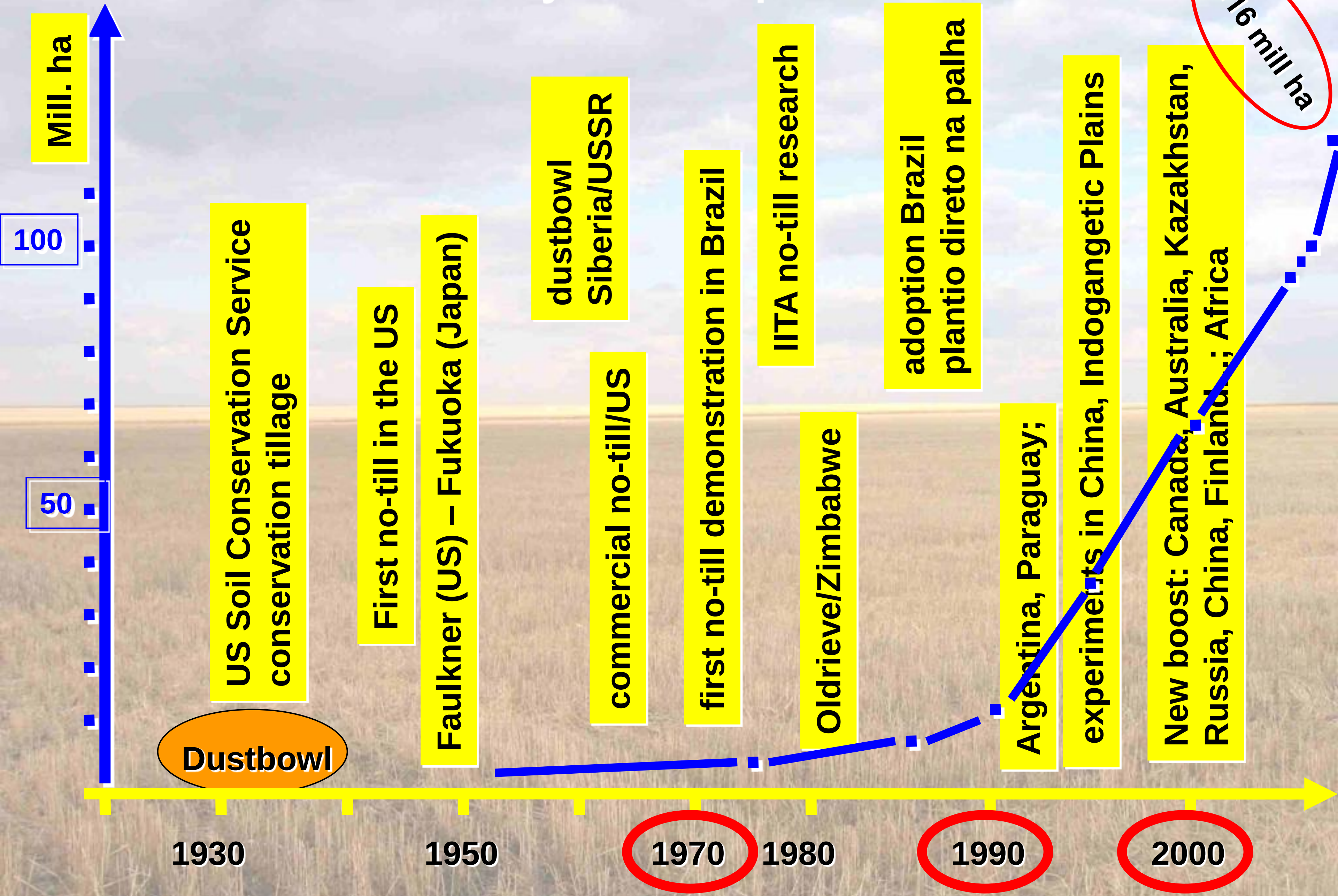
- Residues are a better C-source for soils

Further options:

- **Integrated Crop-Livestock systems**

- **Agroforestry:**
  CA with trees (CAWT)

History and Adoption of CA



Sequestration:

Some soil carbon sequestration rates

Brazil

Region		Rate
		Mg ha^{-1} yr^{-1}
Tropical (West-Central BR)	Range	0.04 – 0.63
	Mean	0.39
Subtropical (Southern BR)	Range	0.04-0.97
	Mean	0.58
Temperate (USA)	Range	0.1-0.5
	Mean	0.34
GLOBAL	Mean	0.57

Tropical: Corazza et al. (1999), Silva et al. (2001), Leite et al. (2001)
Subtropical: Bayer et al. (2000a,b), Lovato (2001), Amado et al. (2001), Freixo et al. (2002)
Temperate: Lal et al. (1999); West & Marland (2002)
Global: West & Post (2002)

Slide taken from Amado 2008, CACOC/CTIC-FAO

Sequestration:

- Intensive grassland: 2-7 $Mg \cdot ha^{-1} \cdot a^{-1}$
- New saturation:
  - cropland 30-50 years
  - grassland 15-20 years
- Actual growth in CA: 6 mill ha/a, increasing
- Outlook: in 20 years global CA adoption rate at 50%?

Emission reductions:

- Rice: CH_4
  - up to 90%? – comparable to normal irrigated crops, with SRI approach in CA
- Nitrogen fertilizer: N_2O
  - with CTF or permanent bed up to 5000 kg/ha and crop in CO_2 equivalent (China)
- Fuel emissions: 40 to 70% reduction
- Emissions from input manufacturing
  - 50% less machinery
  - 30-50% less fertilizer
  - 20% less pesticides

Emission reductions:

- Manure handling:
  - biogas: 0.01 (broiler) – 4.4 (dairy cow) t/a in CO_2e per animal
  - aerobic composting: 99% (compared to open anaerobic lagoon)
  - application into cover crops/crop residues
  - knifing into soil (small quantities)

Conclusions:

- Agricultural land management is a major player in climate change
- Agriculture is not an option: needs to & can reduce its environmental footprint
- CA responds to many global problems and is expanding globally
- Agriculture with CA (+SRI+AF) could become a major core element for global environmental policies
- BUT: no simple quick fix; complementary measures needed – optimized protocols
- “Carbon” as new produce from farming

Sustainability and Food for all: With CA agriculture can become part of the solution!

Thank you for your attention!

More information:

http://www.fao.org/ag/ca