Competition for land: food/climate mitigation/conservation

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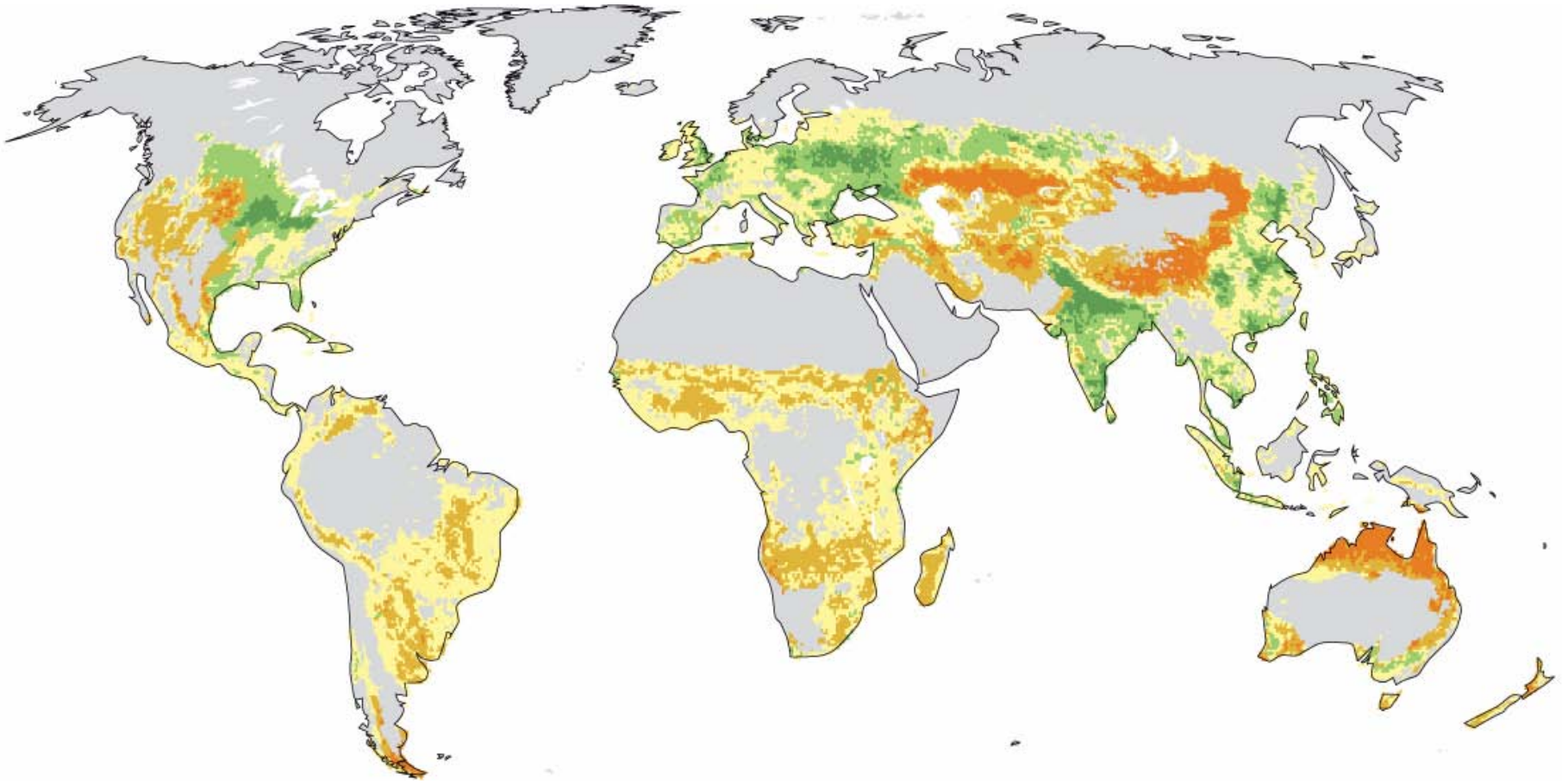
WORLD LAND TRUST™

Farmed land areas 2005 (% change from 1961) FAOSTAT

Total arable and permanent cropland area: 1,562 Mha (+12%)

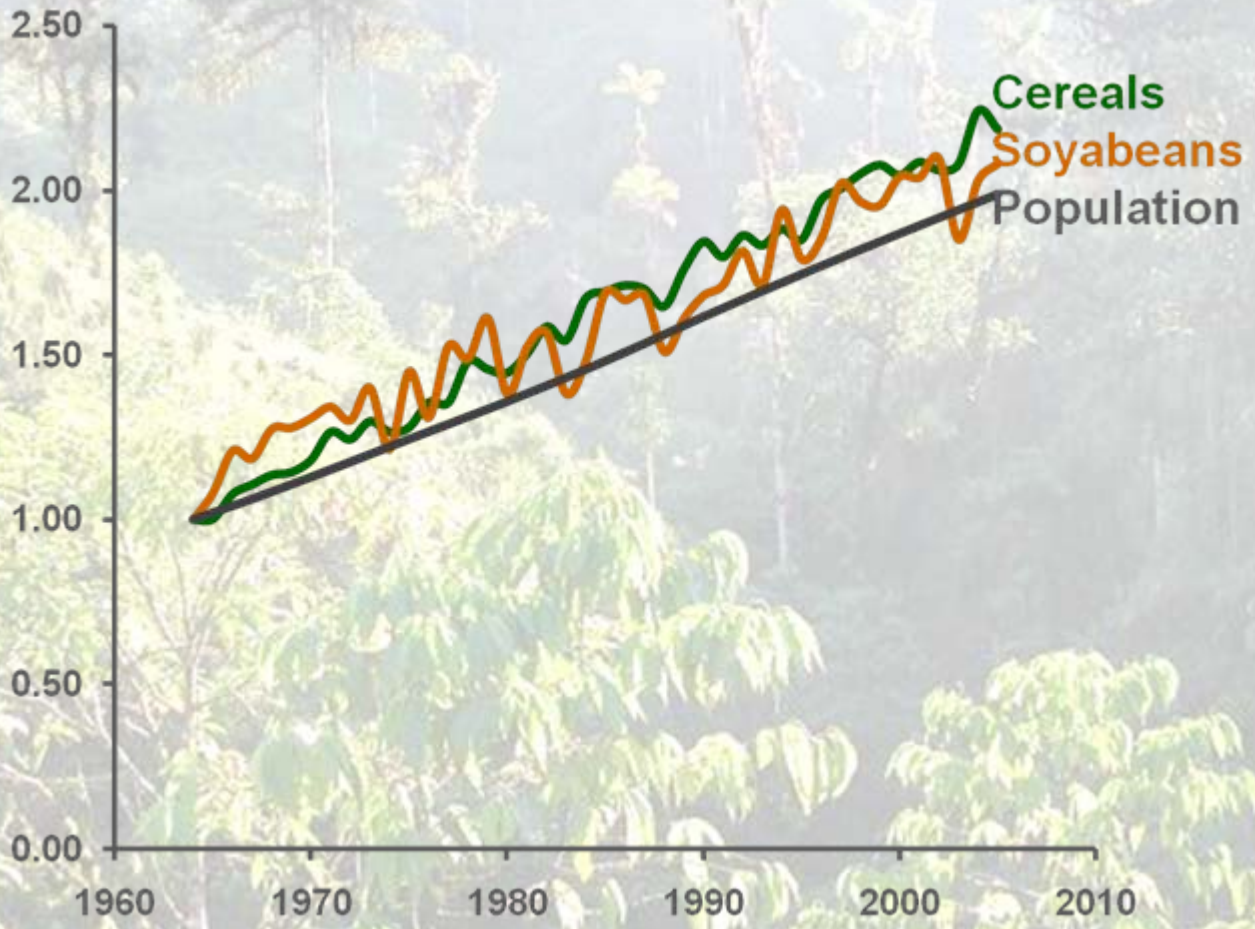
Total permanent pasture 3,406 Mha (+9%)



Map: http://maps.grida.no/library/files/storage/5_4__agriculturearea2.pdf

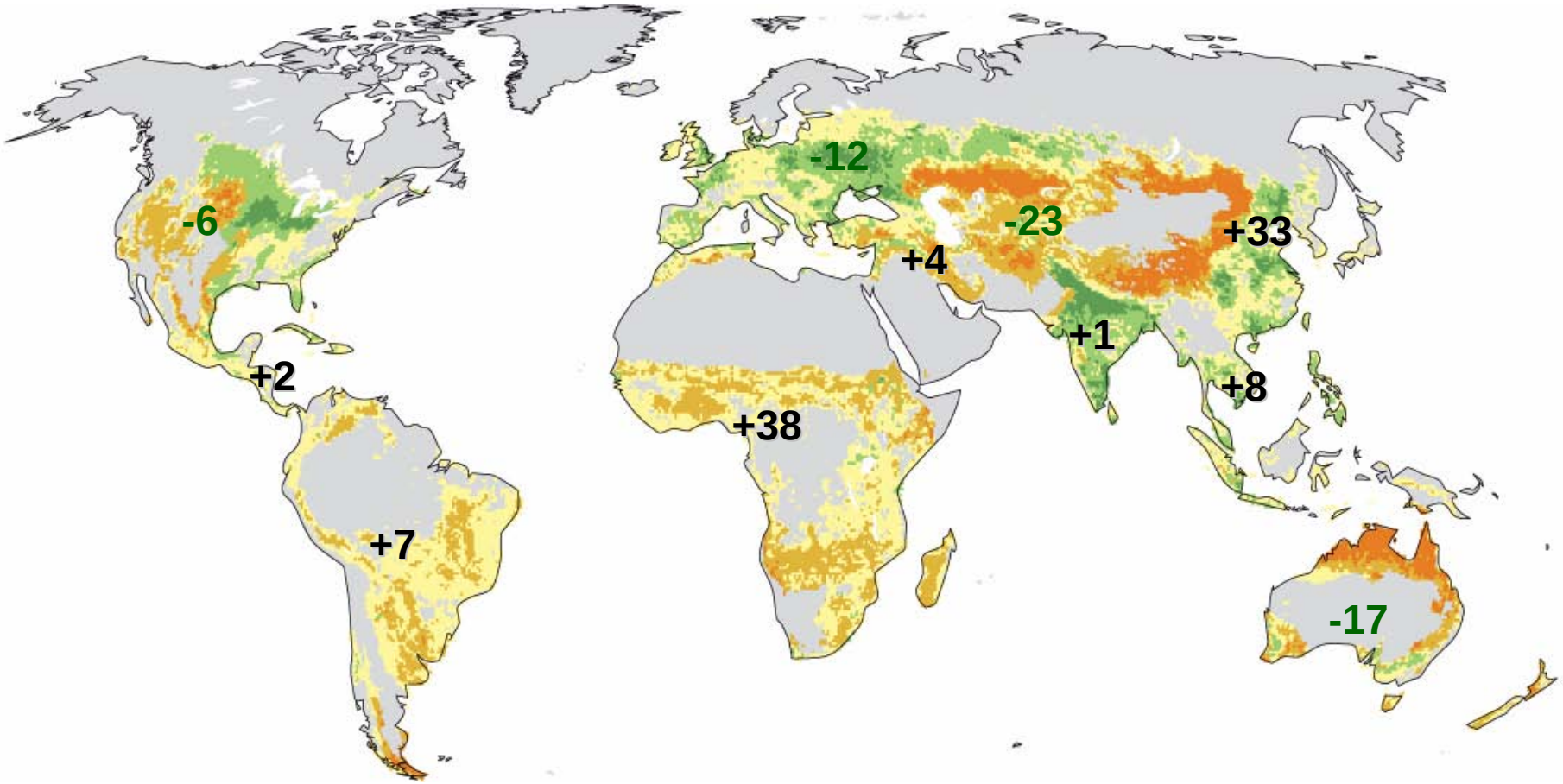
World agricultural yields and population growth

Source FAOSTAT



Change in farmed land areas 1995 to 2005: Mha

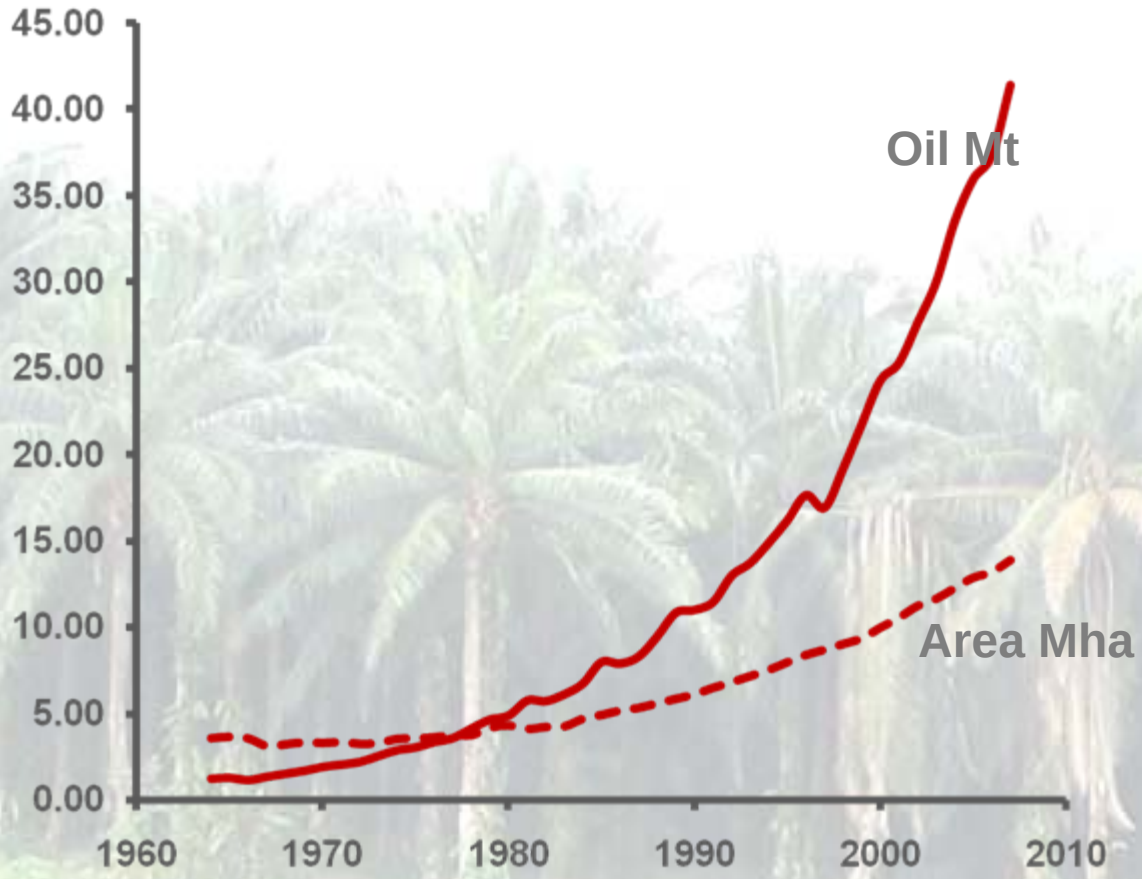
Area data FAOSTAT



Map: http://maps.grida.no/library/files/storage/5_4__agriculturearea2.pdf

	Area growth 1995-2007 %/yr	Area growth 1995-2007 Mha
Oil palm	4.3	6
Soya	3.2	29
Oilseed rape	2.1	6
Sugar cane	1.5	3
Maize	1.4	22
Rice	0.5	7
Wheat	0.1	1
Potato	0.5	1
Beans	0.4	1
Millet	0.0	0

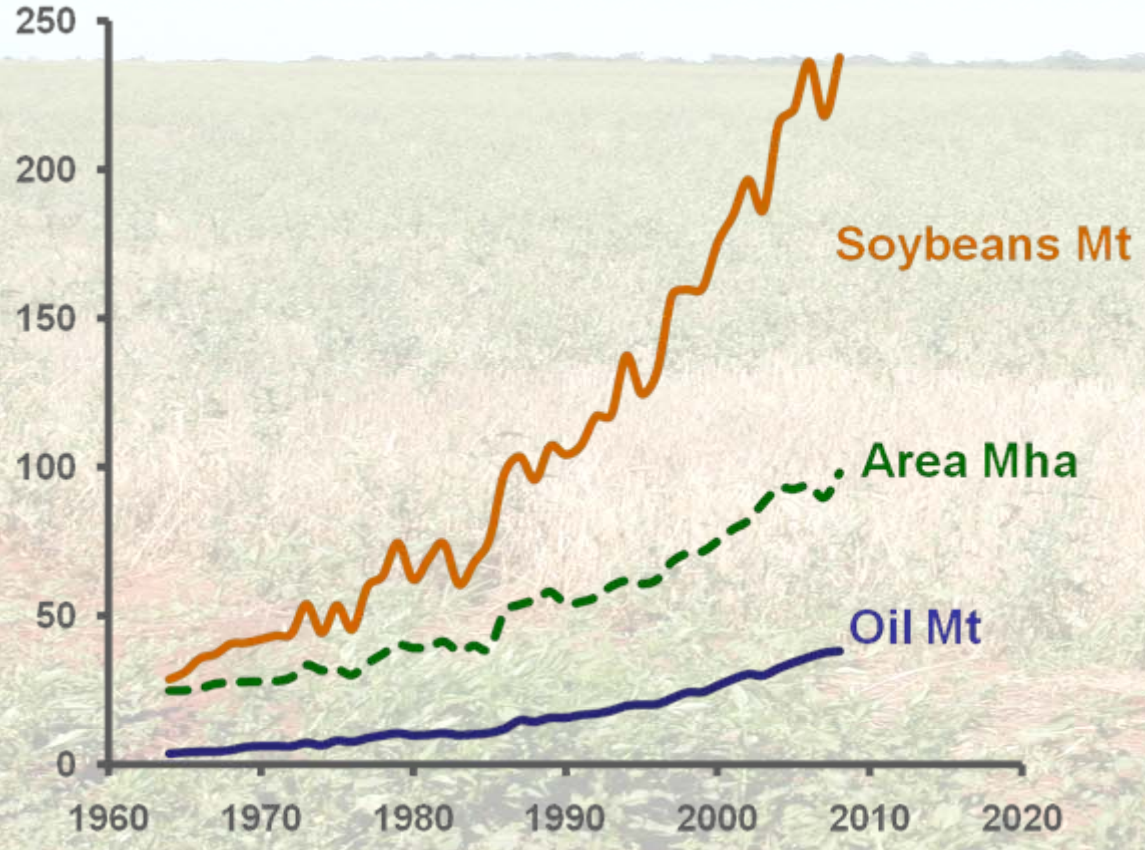
Over 80% of palm oil comes from SE Asia; an additional 6 Mha has been planted since 1995



Global palm oil production FAOSTAT


Photo courtesy of **Wetlands International**

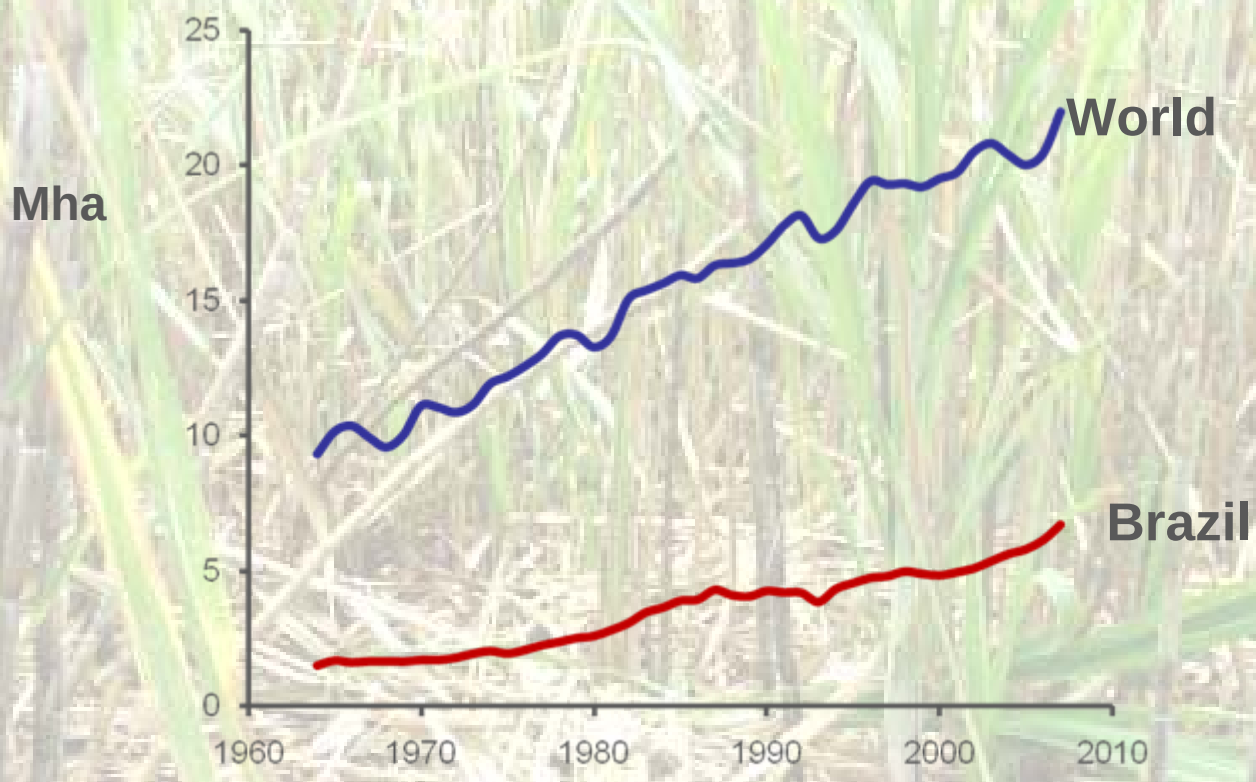
In S America, the area under soya has doubled since 1995 to over 40 Mha



Global soya production FAOSTAT

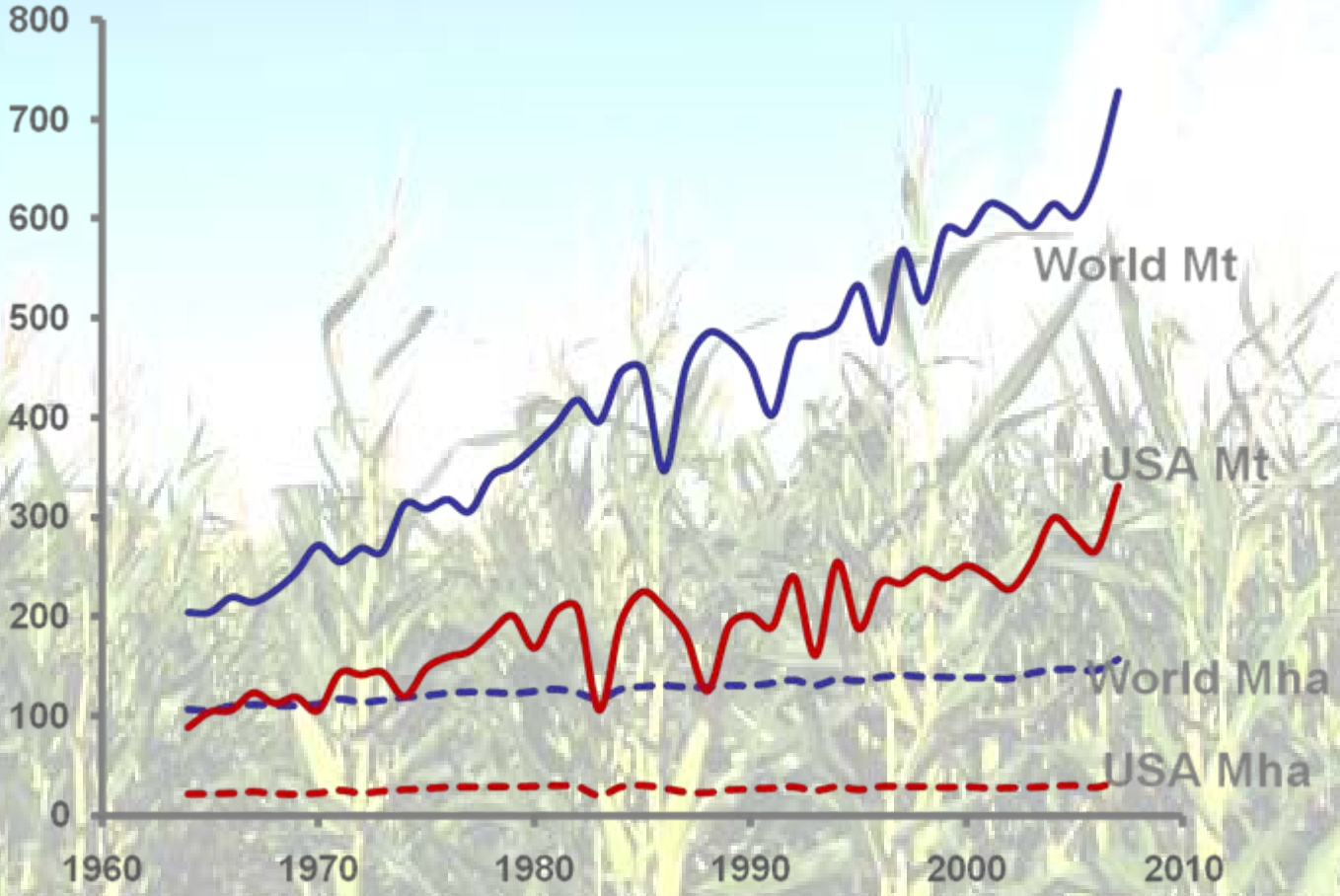

PRO COSARA
RESERVA
SAN RAFAEL

Over half of Brazil's 7 Mha of sugar cane is used for bioethanol



Sugar cane area FAOSTAT

The USA accounts for nearly half of global maize production; a third of US production (from c10M ha) will be converted to ethanol in 2008



Global maize area and production FAOSTAT

The US bioethanol programme has global effects:

US maize diverted to ethanol

↓

US soy and wheat land move to maize

+

Maize, soy and wheat prices rise

+

US agricultural exports fall

↓

Production in S America and Asia increases (but lower yields mean more land used)

Searchinger *et al,* 2008. Science **319**, 1238-1240.

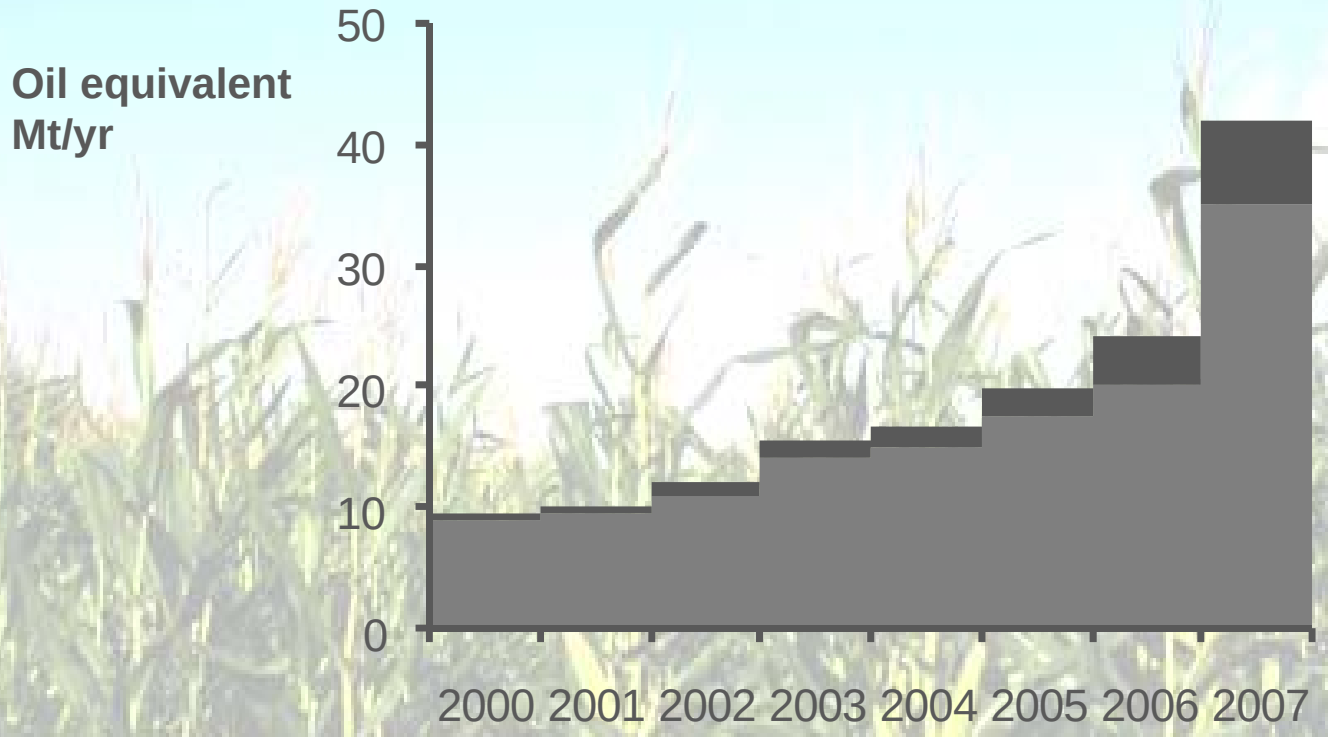
Bioethanol production increase of 56 M m^3

- **takes 13 Mha land for maize in USA**
- **displaces 11Mha of other crops**
- **leads to11 Mha of new arable conversion elsewhere:**

USA 2 Mha
Brazil 3 Mha
Asia 2 Mha

Searchinger *et al*, 2008. Science **319**, 1238-1240.

Global production of transport biofuels



Biodiesel ~ 8Mha
palm, soya, rapeseed oils

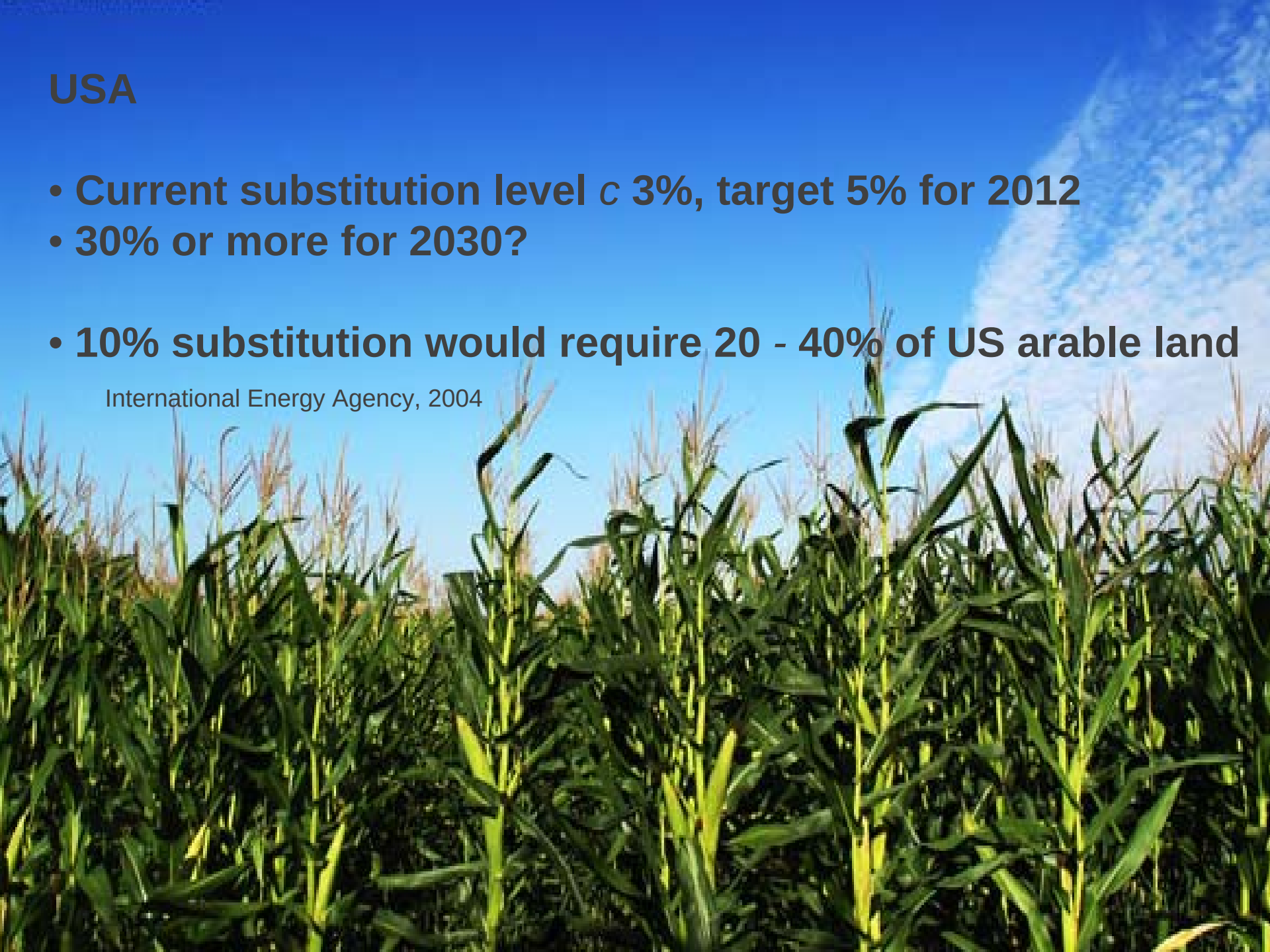
Bioethanol ~ 15Mha
maize, cane, beet

Sources: IEA, 2007; FO Licht 2007

EU Renewable Transport Fuel Obligation

- **5.75% substitution target reduced to 5% (2015) increasing to 10% (2020)**
- **5% needs 10 – 24% of EU agricultural land**

Source: European Environment Agency



USA

- **Current substitution level *c* 3%, target 5% for 2012**
- **30% or more for 2030?**

- **10% substitution would require 20 - 40% of US arable land**

International Energy Agency, 2004

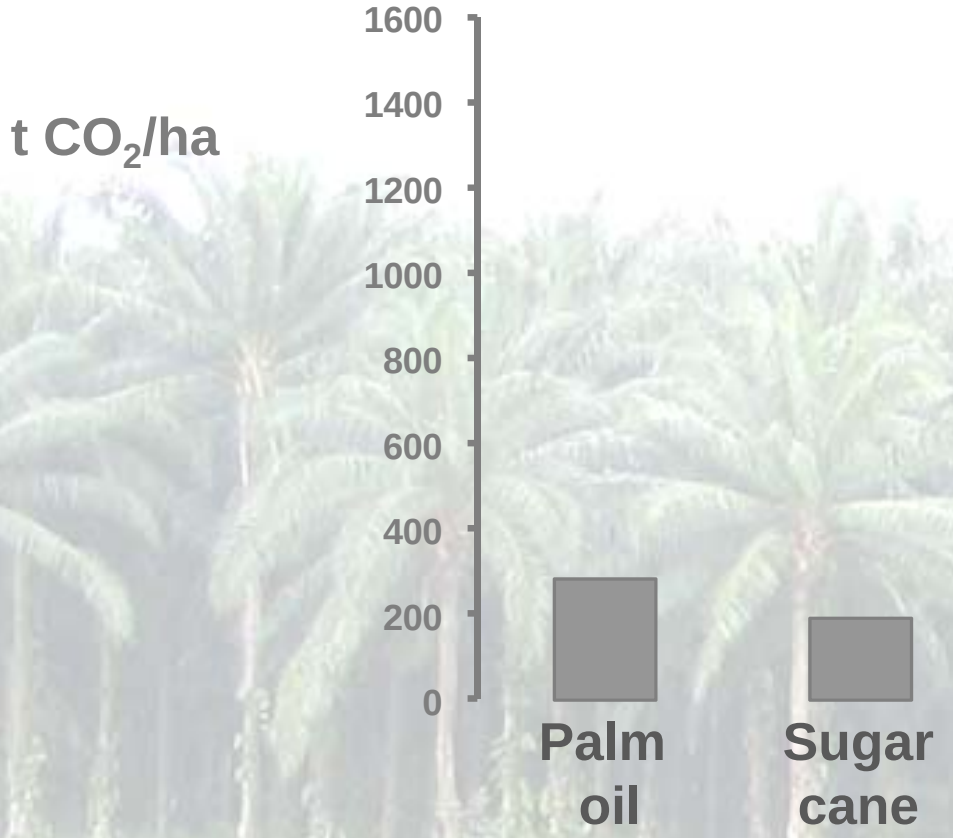
There is not enough arable land for today's biofuels to make major inroads into fossil fuel use:

Using current biofuel technology, 100% global harvest of maize + sugar cane + palm oil + soya oil could replace 3% of fossil energy use

Field, Campbell & Lobell, 2007 *Trends in Ecology and Evolution* 23 65-72.

To replace 60% of global transport fuels would require approximately all present arable land area

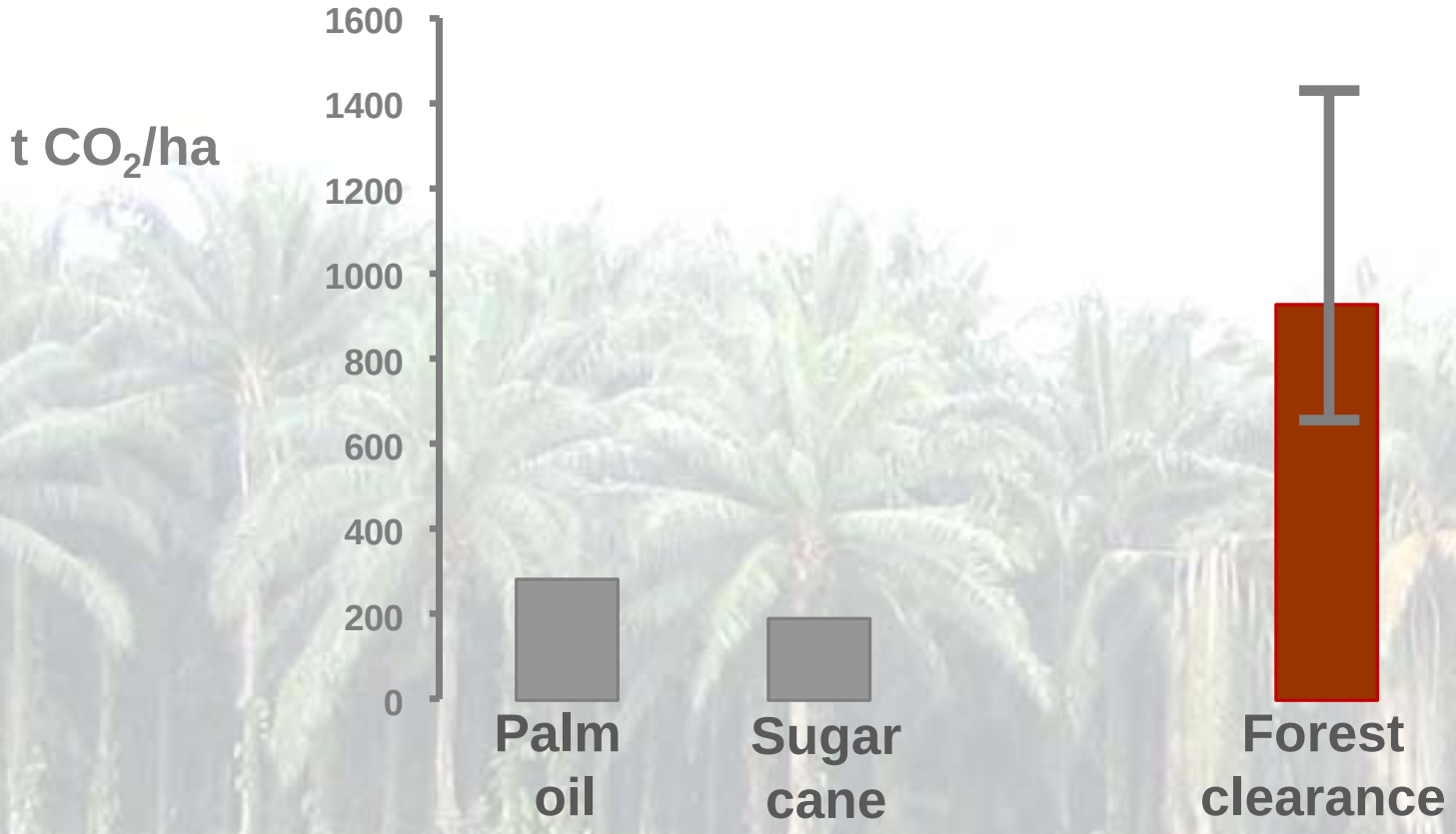
Are biofuels effective in carbon mitigation?



Avoided emissions over 30 years

Based on: Righelato & Spracklen, 2007. Science 317, 902

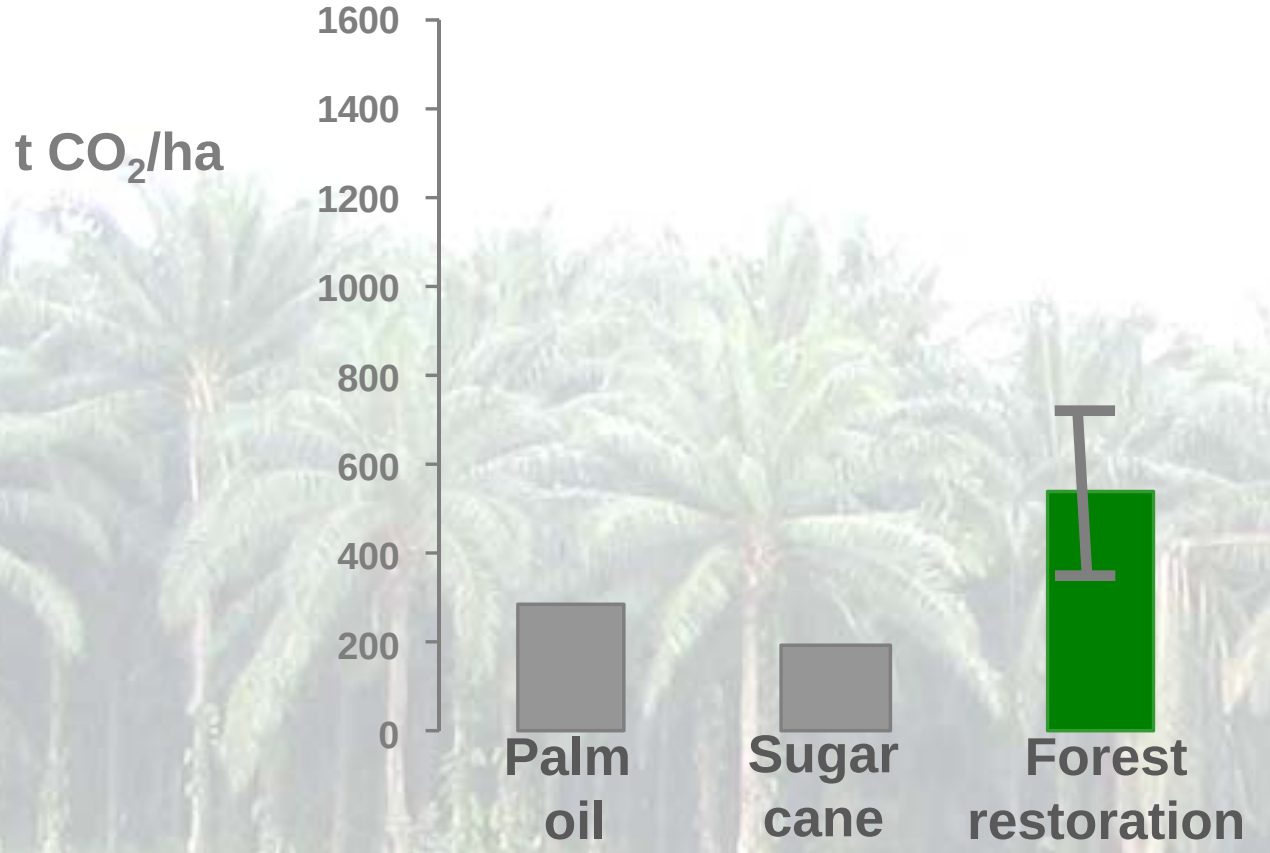
Emissions from forest clearance outweigh avoided emissions.



Avoided emissions over 30 years compared with carbon lost in land clearance

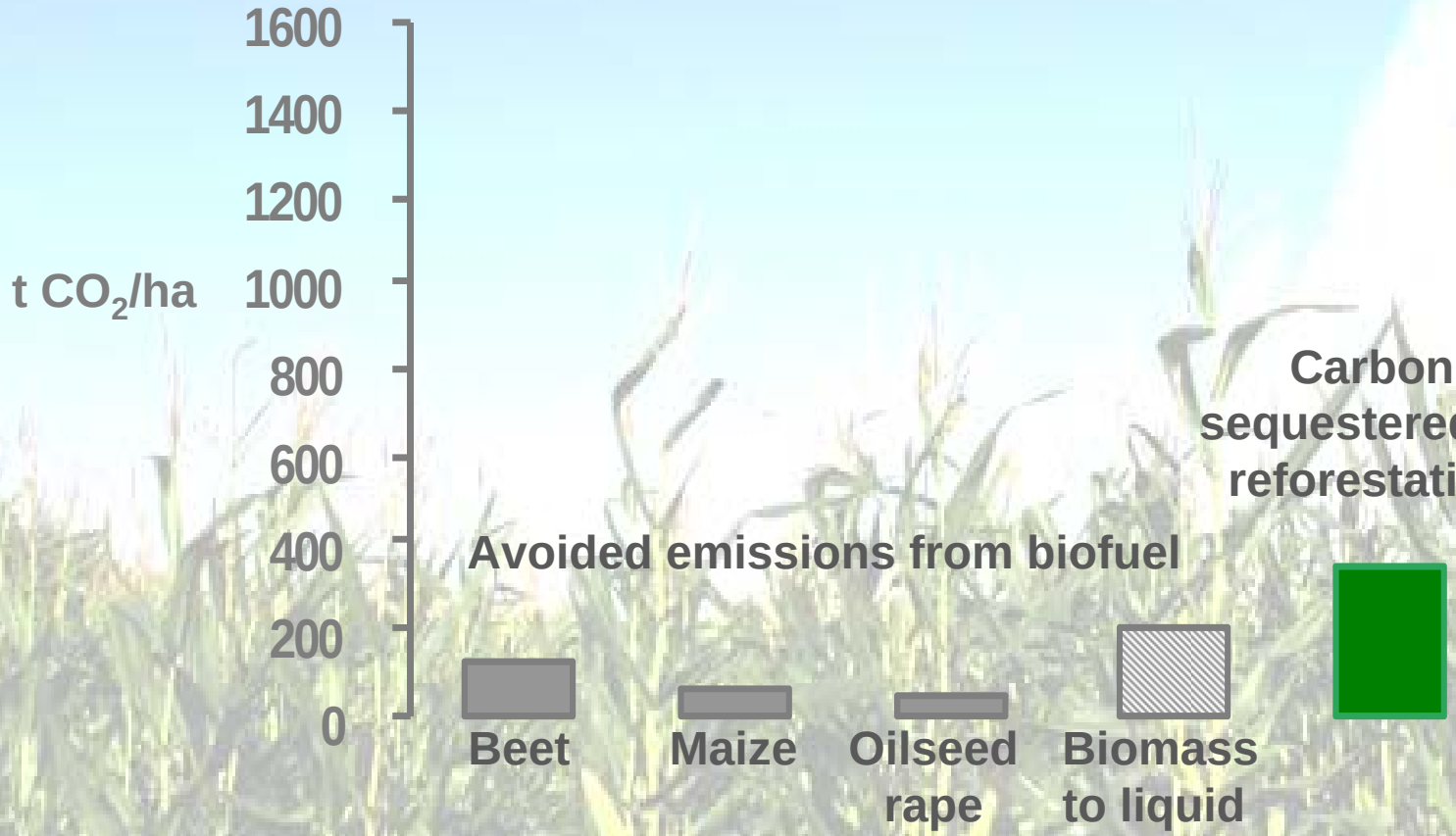
Based on: Righelato & Spracklen, 2007. Science 317, 902

In most cases, the opportunity cost of not restoring forest exceeds the emissions avoided by biofuels use.



Avoided emissions over 30 years compared with carbon sequestered by reforestation

Based on: Righelato & Spracklen, 2007. Science 317, 902



Carbon mitigation over 30 years – temperate zones

Source: Righelato & Spracklen, 2007

For mitigation of CO_2, maintaining and restoring forest is generally more effective than current biofuels.

	Avoided emissions[1] t CO_2/ha-yr
Avoided deforestation in tropics[a]	**~ 30**
Tropical forest restoration [a]	**~ 15**
Biodiesel (palm oil)	**~ + 10 / - 20**
Bioethanol (sugar cane)	**~ + 10 / - 20**
Bioethanol (maize)	**~ 1.5**

[1] Based on Righelato & Spracklen, 2007: Science 317, 902
[a] averaged over a 30 year period

s land available? Is restoration economically feasible?

~ 1.6 Gt CO_2/yr (2030) at < US**$20/t CO_2**

~ 30% from forest restoration + afforestation (A/R)

~ 70% in the tropics

Narbuurs *et al* 2007. IPCC Fourth Assessment Report

s land available for restoration - is it economically feasible?

~ 1.6 Gt CO_2/yr (2030) at < US**$20/t CO_2**

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Narbuurs *et al* 2007. IPCC Fourth Assessment Report

For reforestation this implies:

~ 50 Mha land + ~ US**$10 billion/yr**

Costs of restoration projects

Compensating stakeholders for lost income and resources

Land conversion
(fencing, tree planting; wetland restoration *etc*)

Maintenance, monitoring, management

Enforcement

Transaction costs, registration *etc*

Provision for leakage and impermanence

How might restoration be funded?

Carbon compliance markets
•forest projects limited under Kyoto's CDM
•forest credits excluded from EU ETS *et al*

Institutional and government grant funding

Voluntary markets for carbon and other ecosystem services

Charitable support