Sustainable land use for the 21st century

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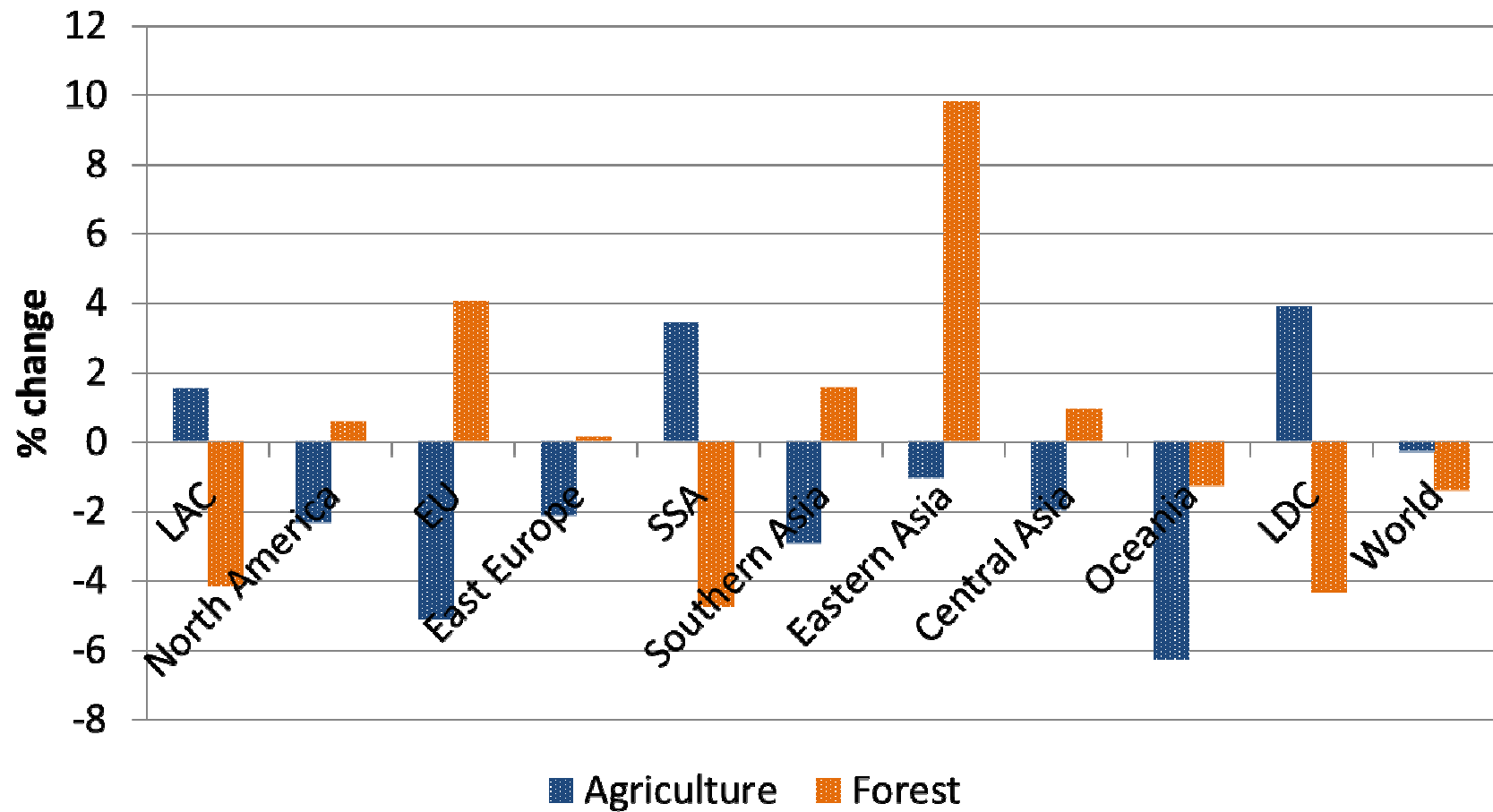
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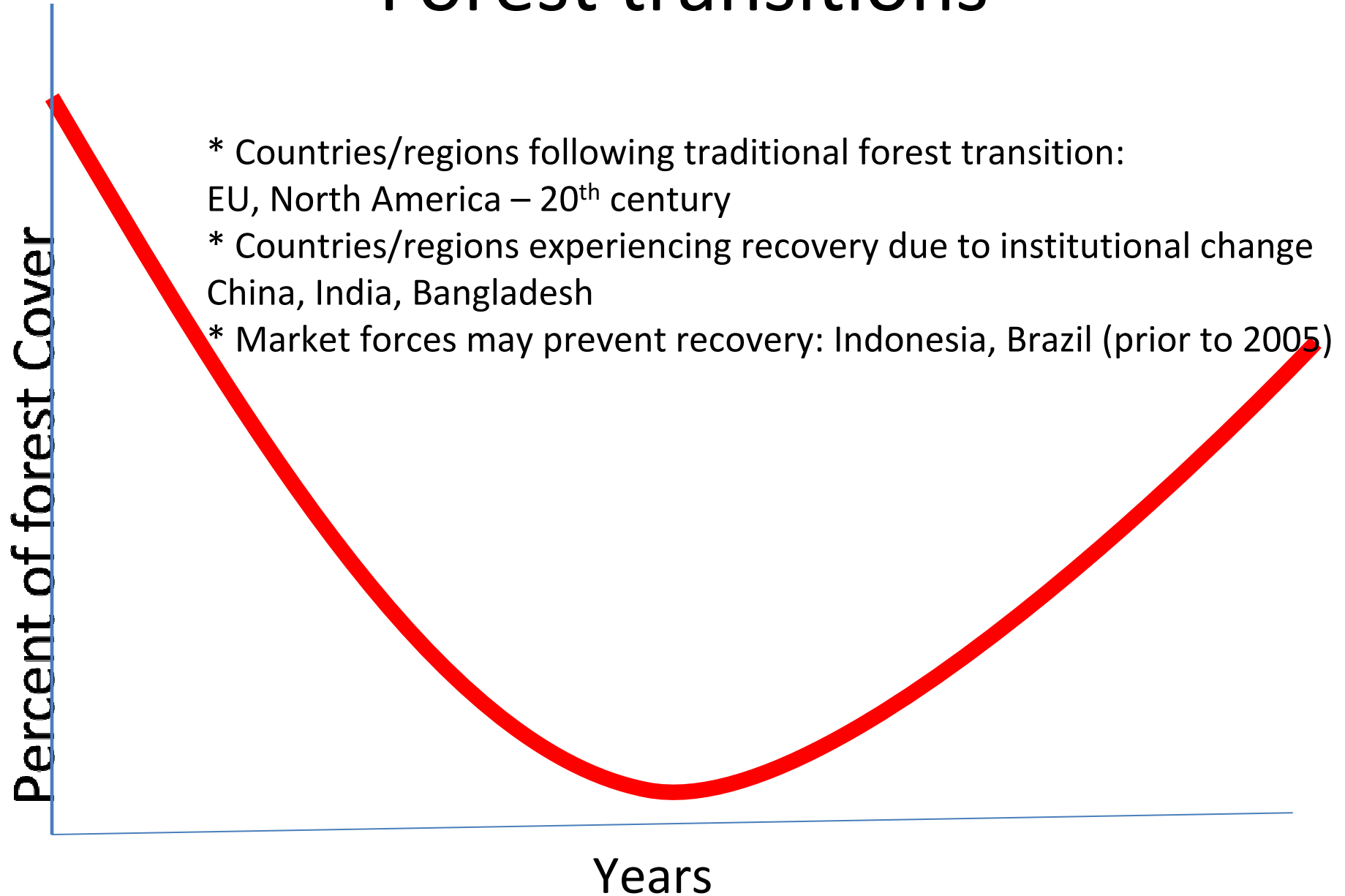SooJin Park – Seoul National University

Outline

- What science tells us about LUCC?
- How land use change happened in practice?
- Effectiveness of land use management systems
- LUCC modeling
- Prospects for the future

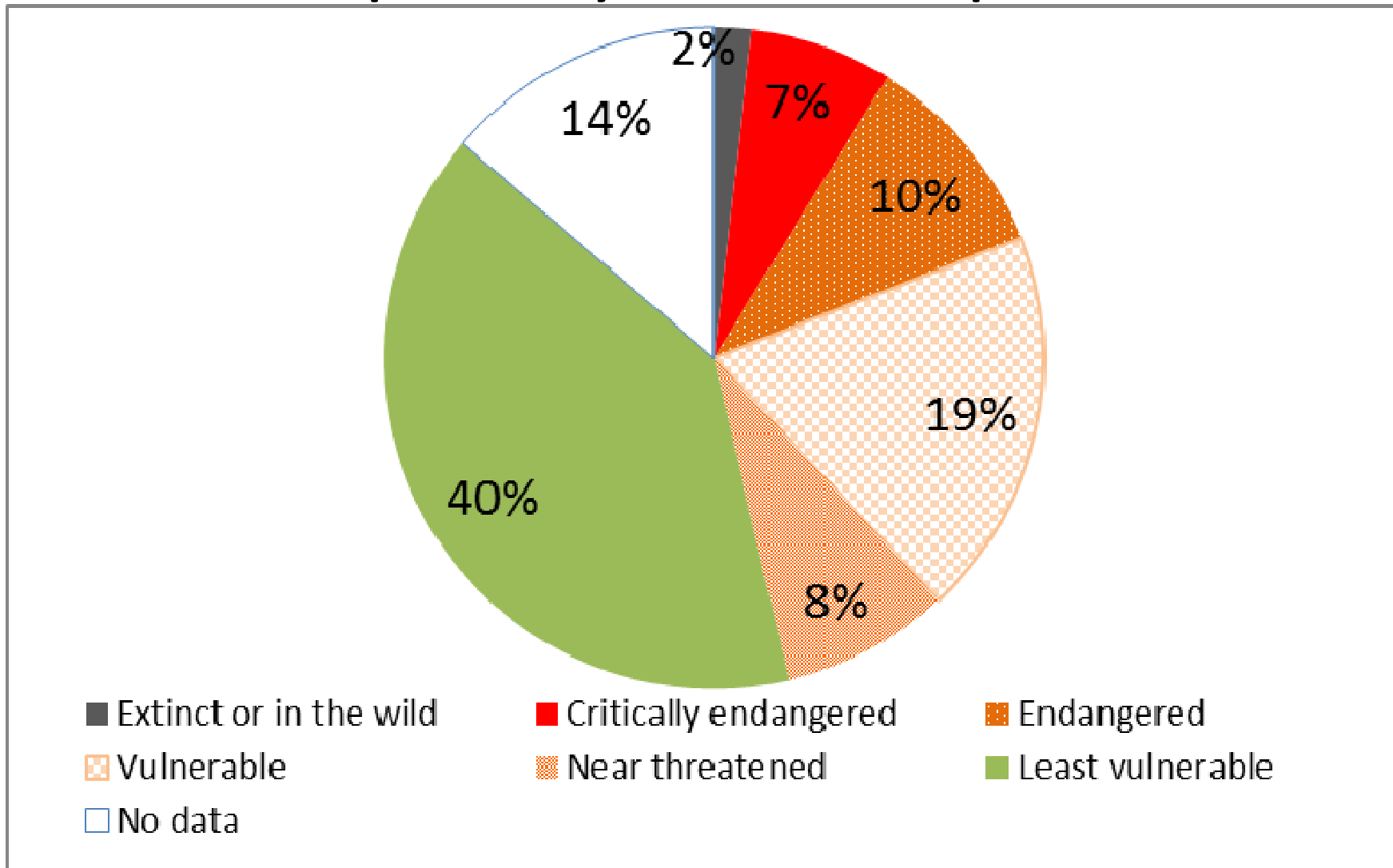# Change of agriculture and forest area, 1992-2009

Forest transitions

* Countries/regions following traditional forest transition: EU, North America – 20th century
* Countries/regions experiencing recovery due to institutional change China, India, Bangladesh
* Market forces may prevent recovery: Indonesia, Brazil (prior to 2005)

Percent of forest Cover
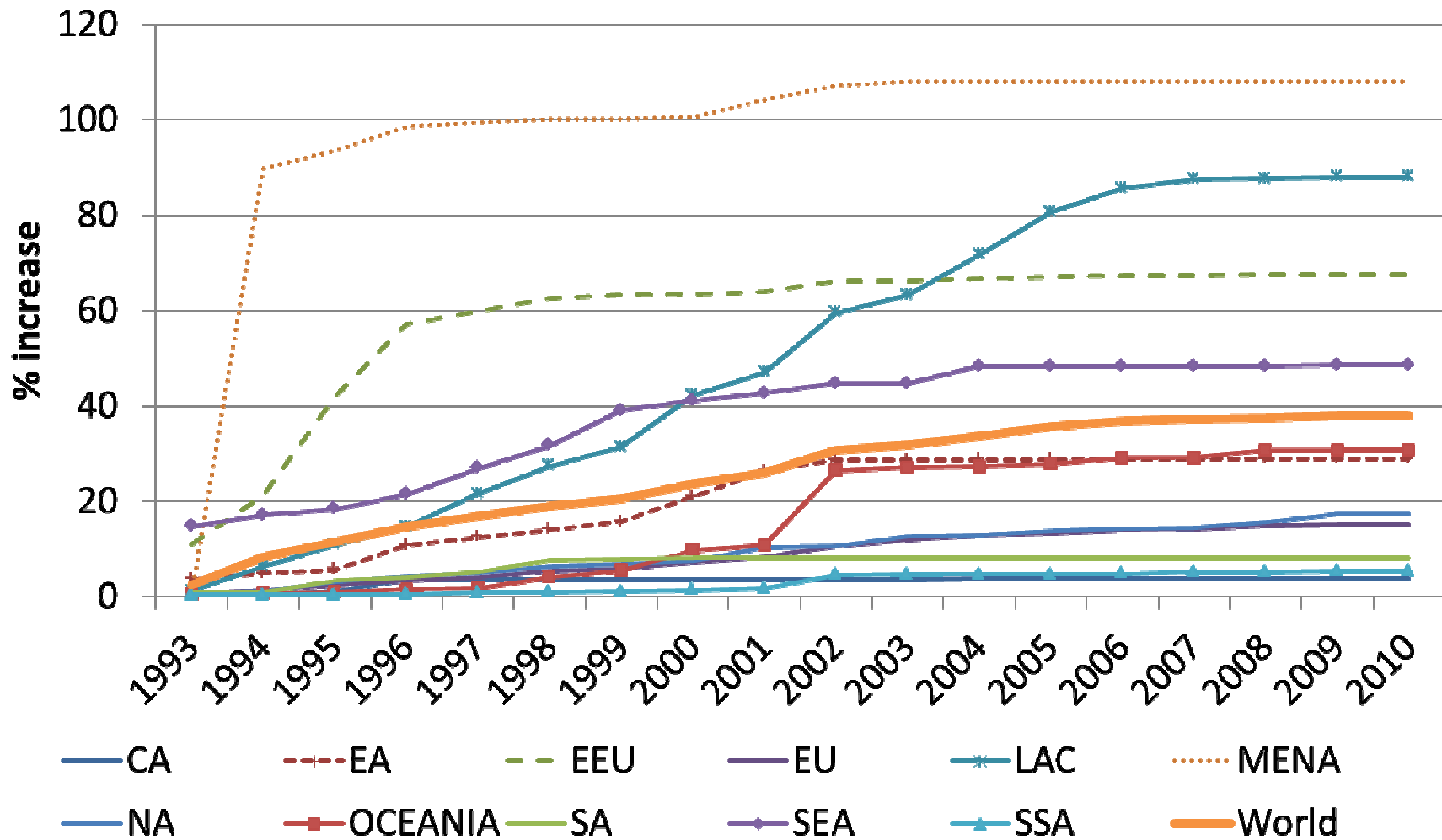
Years

Demand for water

- Demand for water expected to double from the current level of 7,130 km^3 to 12,050 to 13,500 km^3 in 2050 (CA 2007)

- Under BAU, about 40% of people will experience water stress (<1,700m^3/year/capita) in 2025 (Revenga, 2000).

Loss of global biodiversity is alarming – especially in the tropics

Pie chart segments:
- 2% — Extinct or in the wild
- 7% — Critically endangered
- 10% — Endangered
- 19% — Vulnerable
- 8% — Near threatened
- 40% — Least vulnerable
- 14% — No data

Legend:
- ■ Extinct or in the wild
- ■ Critically endangered
- ▨ Endangered
- ▨ Vulnerable
- ▨ Near threatened
- ■ Least vulnerable
- □ No data

Source: IUCN (2010)

But, extent of protected area has increased

Drivers of LUCC

- Global land use change due to EU & US bioenergy mandates

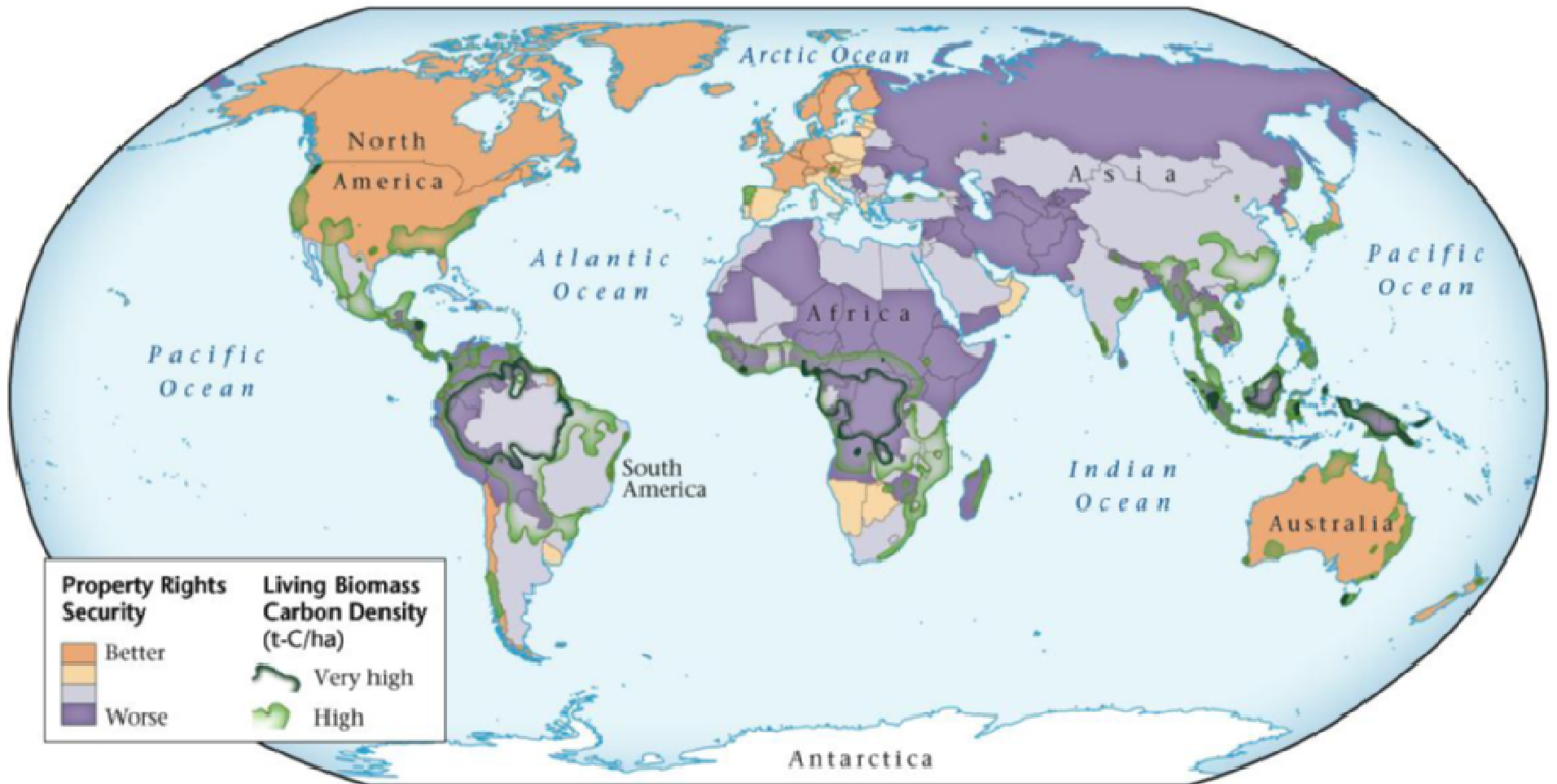|	US	EU-27	Brazil
	2006-2015 (% change)		
Crop	0.3	0.7	1.1
Forest	-0.7	-2.1	-2.6
Pasture	-1.4	-2.3	-2.2
	2006-2015 (% change)		
Crop	0.8	1.9	2
Forest	-3.1	-8.3	-5.1
Pasture	-4.9	-9.7	-6.3

Source: Hertel et al 2008

Food Price trend signals a new pattern
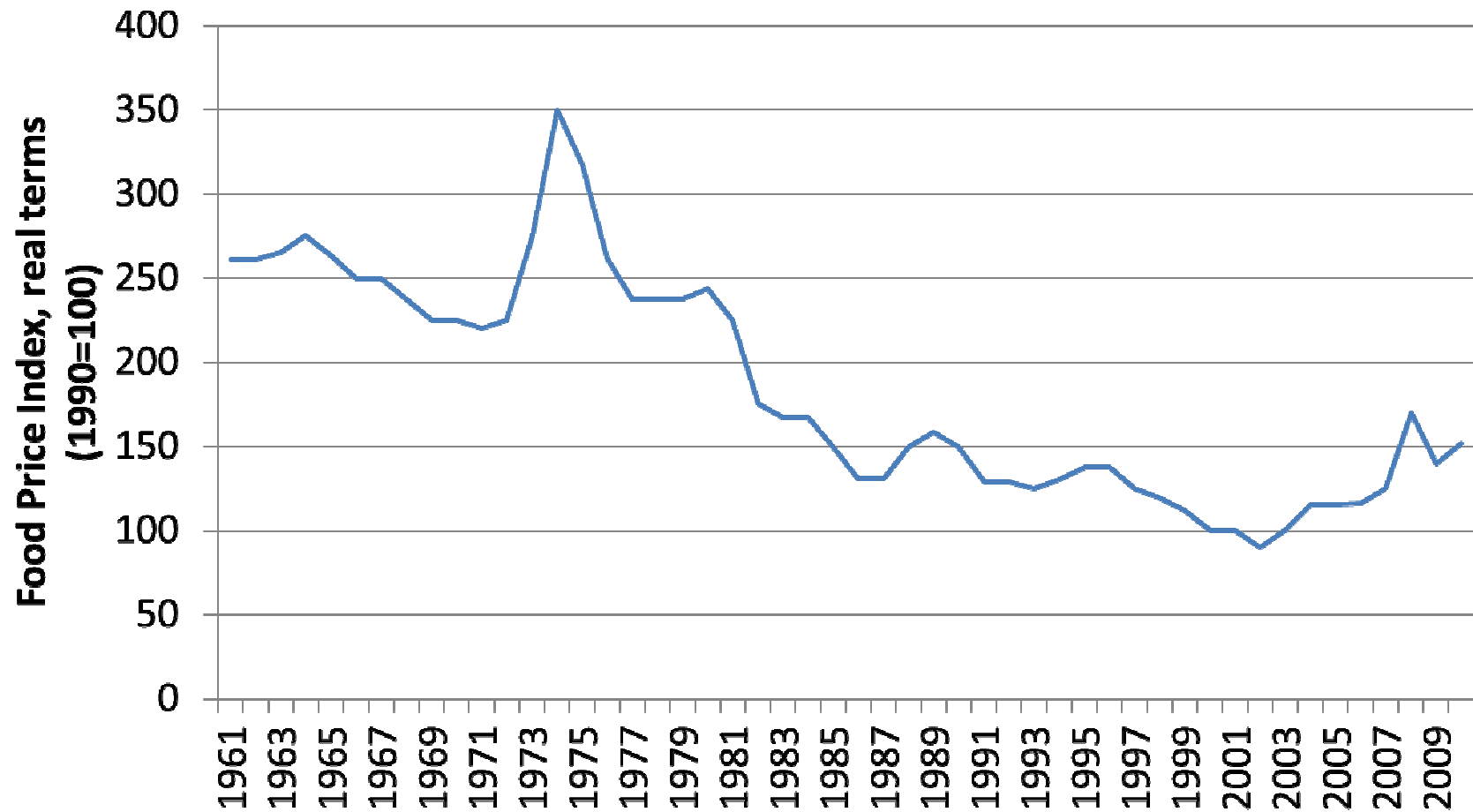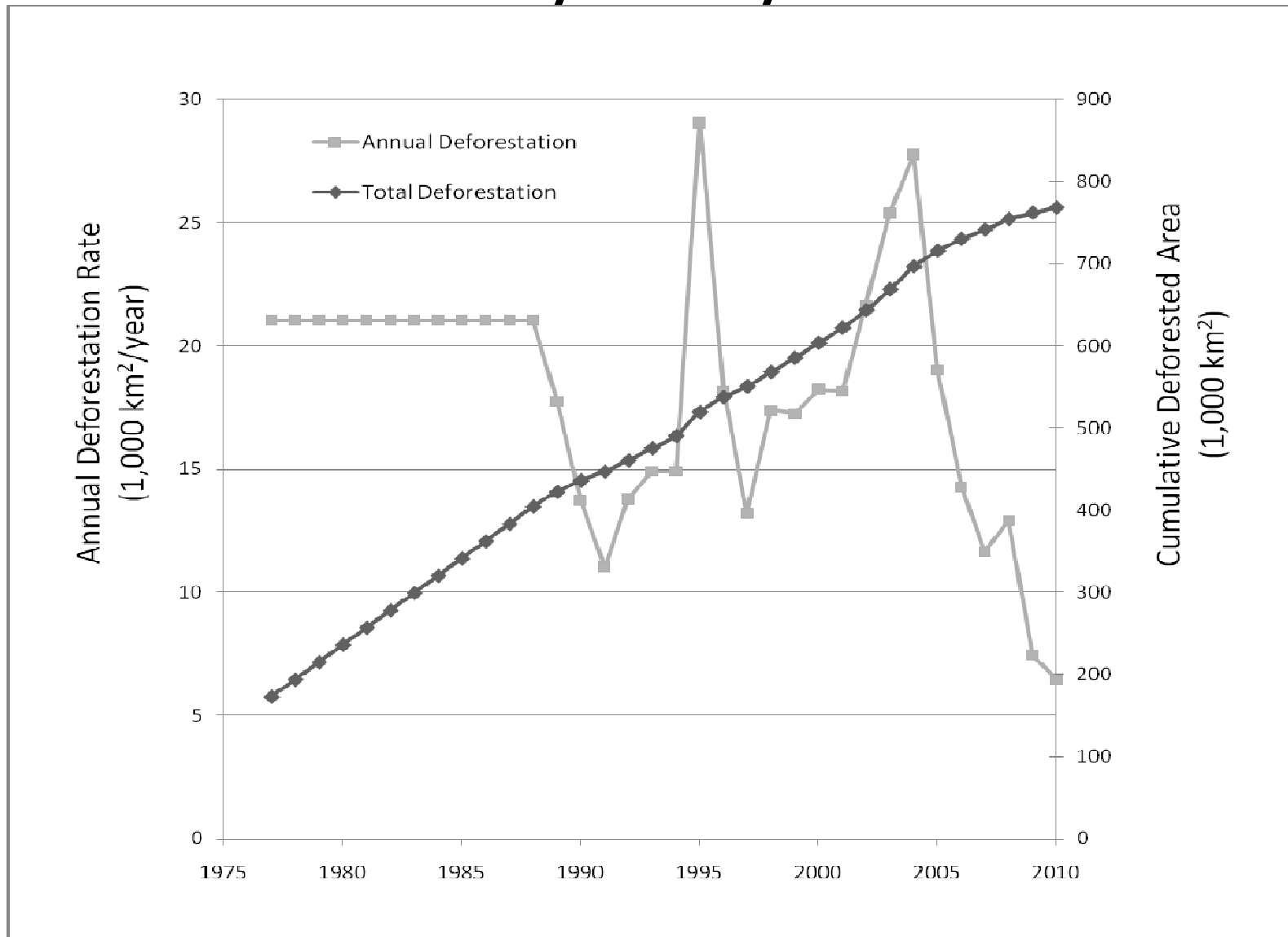

Source: FAO 2011

Land tenure security negatively correlated with living carbon density

Source: Bruce et al 2010

How land use change happen in practice? Case of Brazil, Indonesia & DRC

Brazil reduced deforestation by 74% in only five years

Indonesia

- The palm industry - driving forces of deforestation (Grieg-Gran 2008).

- Commercial logging ~ 60% of Indonesia's 100 million ha of forest allocated to commercial logging between 1970s to 2000 ➜ 70 million m^3 annual harvesting (sustainable level =25 million m^3) (Casson 2001).

- Decentralization of forest management contributed to the deforestation

- Indonesia entered into contract with Norwegian to suspend all concessions. Deforestation rate fell from 1.7% in 1990-2000 - to only 0.5% in 2000-2010 (FAO 2011)
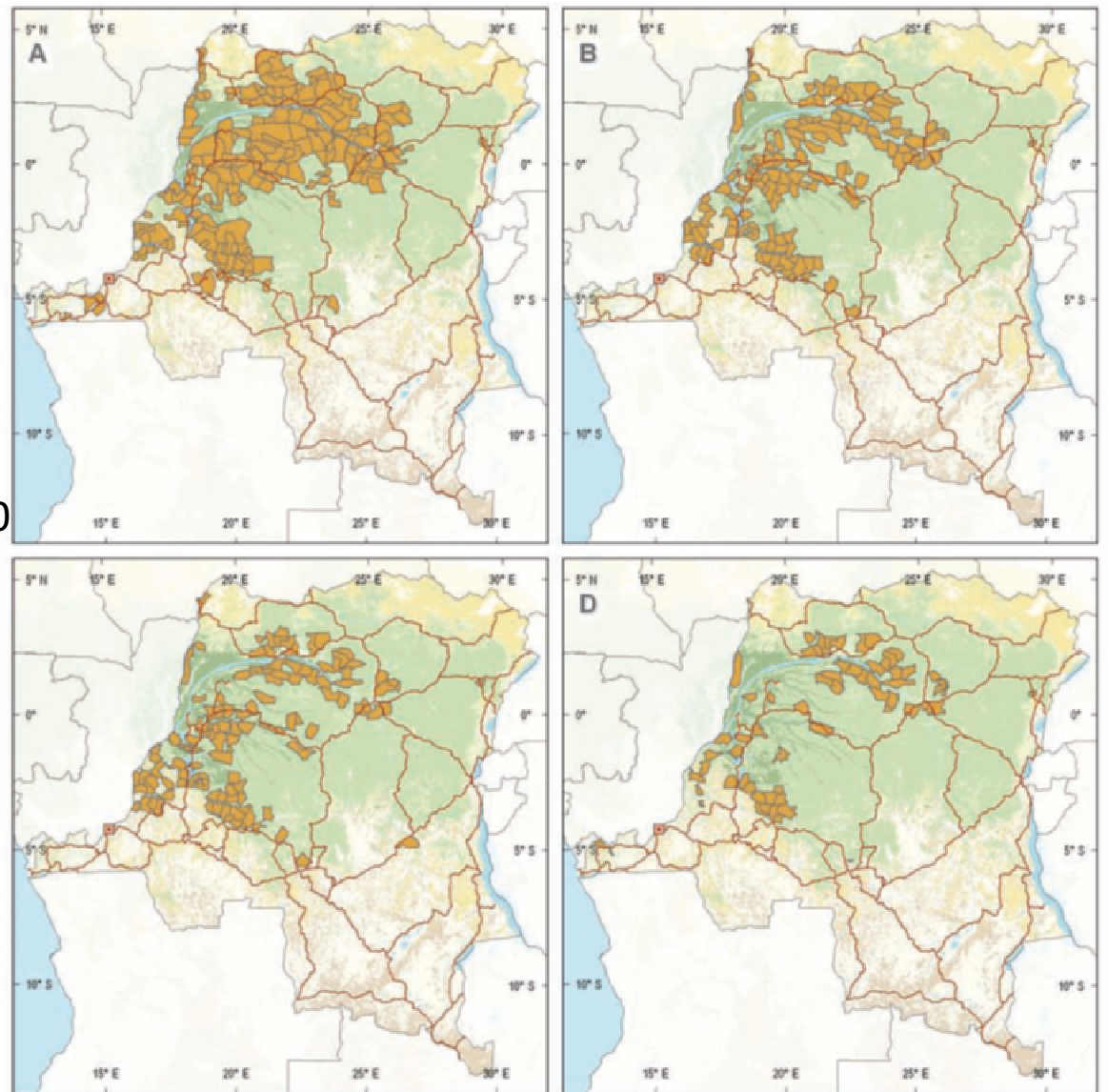
DRC

- Poor infrastructure & insecurity has led to limited logging and other forms of forest harvesting in DRC
- CDM and other international instruments are hard to implement in DRC due to the weak institutions.

DRC: Changes in area allocated to timber concessions

	A	B	C	D
Year	2000	2003	2007	2009
Area (million ha)	42	25	26	12

Source: Mertens and Bélanger, 2010

Land management systems

- Global efforts to manage LUCC have grown significantly out of concern of the impact of rapid LUCC change on biodiversity, climate change, environmental pollution.
  - Government zoning, rules and regulations
  - Market-based instruments (MBI) (e.g. taxes, forest certification)
  - Cap-and-trade
  - PES
- Experience has shown that
  - market-based instruments work best in high income countries and poorly in low income countries – especially those with weak governance
  - Complementary programs including MBI, cap-and-trade programs, PES, and government-enforced regulations are more effective than use of one or few programs.
- Daunting challenges remain in implementing CDM & other global program.
  - PES - inequitable compensation for areas with high opportunity cost of conservation and verification of additionality for places where the opportunity cost of conservation is low.

LUCC modeling

- Over the past three decades, the accuracy of the land use and land cover (LUCC) modeling has improved due to the increasing use of a combination of LUCC models from different disciplines. Use of integrated LUCC models allows researcher to account for many drivers of LUCC.

- However, LUCC models – which are calibrated using historical data – still face challenges accounting for unexpected changes in the drivers of LUCC. For example, the recent land large foreign investment which led to greater conversion of land to agriculture was not captured by LUCC models. Neither did the policies in Brazilian which led to the dramatic reduction of deforestation.

What is achievable under BAU?

- Conversion of land to agriculture will exceed the safe planetary boundary. Currently, cropland land area is 12% but one estimate shows that the safe boundary is 15%. Some studies have actually concluded that the current global agricultural production has already stepped outside the safe boundary.
- Loss of biodiversity will continue at the current alarming rate – especially in the tropics.
- Scarcity of freshwater resources will also increase – further increasing its availability and the cost of the goods and services which are produced using water.
- Demand for bioenergy will increase by 35% by 2035. A large share of the new area for production of feedstock will come from clearing forests and conversions of pastureland. Additionally, food prices are likely to increase. This justifies the current concern on using bioenergy to reduce GHG emission.

What is achievable?

- Food security is achievable but this will largely be done by closing the gap between crop yield potential and actual yield.
  - This will also require investments in multiple sectors to take advantage of their synergies.
- Reducing biodiversity loss to sustainable levels in the tropics may not be achievable given the current rate of extinction. However, recent efforts to increase protected area have certainly shown that it is possible to slow the biodiversity loss to less alarming rate.
- Recent international cooperation in environmental management has offered hope for addressing the environmental management challenges. But such efforts have been more effective in countries with strong environmental policies. In countries with weak institutions, payment for ecosystem services and other market based instruments have remained a challenge.