The iLUC Factor: A Simplified Approach to Assess GHG Implications of Indirect Land Use Change from Bioenergy

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"The Impact of Indirect Land Use Changes (ILUC)"
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- Berlin
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Products & Material Flows

private, non-profit environmental research, founded in 1977; staff > 120 in 2009; local to global scope of (net)work

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Sustainable Global Energy

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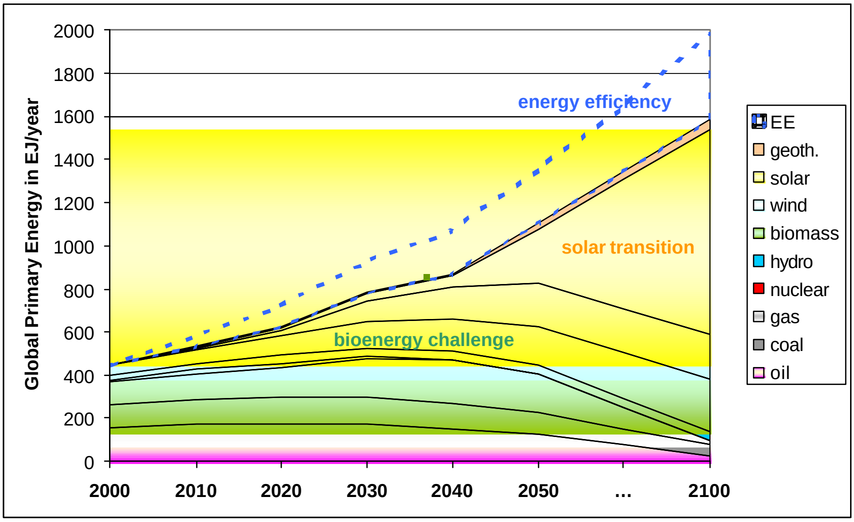

Source: IEA (2007), IPCC (2007), UNPD (2004) and WBGU (2003)

→ Bioenergy will be here to stay, and grow!

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Indirect Effects (Displacement)

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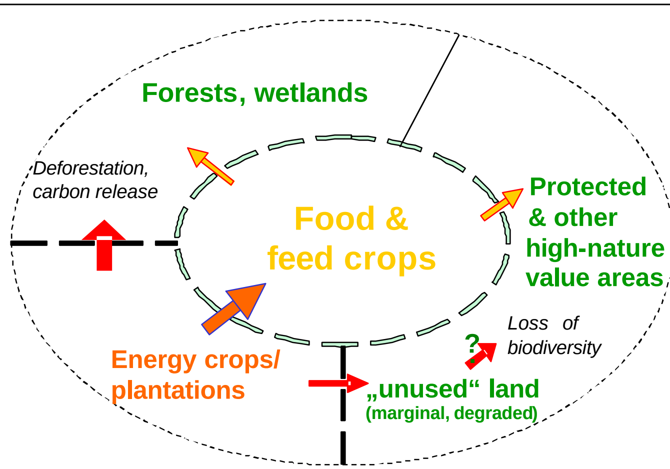

Source: based on Girard (GEF-STAP Biofuels Workshop, New Delhi 2005)

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Indirect LUC

- **Displacement: problem of truncated system boundaries**
  - Accounting problem of partial analysis (only biofuels, no explicit modeling of agro + forestry sectors, or other land uses)
  - **All** incremental land uses imply indirect effects
- **Analytical and political implications**
  - Analysis: which displacement when & where?
  - Policy: which instruments? Partial certification schemes do not help, but have „spill-over“ effects; “adder“ or “malus“ for iLUC GHG
  - **Sourcing priorities**: favor low-iLUC biomass feedstocks
- **Future global GHG regime with cap for all sectors & countries: no leakage = no indirect effects!**
- **Similar for biodiversity regime (CBD)**

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The iLUC Factor Approach (1)

- assumes potential release of CO_2 from dLUC caused by displacement is **function of land used** to produce agro products for exports (displacement “works” along **trade flows**)
- takes into account key countries trading agro-products being subject to displacement which can impact **different land with different C stocks**
- shares of displaced land **derived from land used for agro exports:** rape, corn, palm, soy, wheat in Brazil, EU, Indonesia, US, 2005 yields (FAO)

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The iLUC Factor Approach (2)

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- Average impacts; explicit assumptions which dLUC is likely where (e.g. grassland to maize)
- IPPC-based dLUC emission factors coupled with regional land use shares for each agro commodity
- average CO_2 emission factor per ha of displaced land derived + discounted over 20 years

→ **Calculated theoretical global average iLUC factor: 20 t CO_2/ha/yr if displacement risk would be 100%.**

→ **Real risk lower (set-aside/abandoned land, intensification etc.)**

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The iLUC Factor Approach (3)

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- **Indicative values for iLUC factor (2005)**
  - "low", assuming 25% of biofuels subject to theoretical full iLUC factor = 5 t of CO_2/ha/year
  - "medium", i.e. 50% of feedstock subject to theoretical full iLUC factor = 10 t of CO_2/ha/year, and
  - "maximum", representing 75% share* of feedstock = 15 t of CO_2/ha/year
- **Translating iLUC factor to biofuels: divide by fuel-specific yield, e.g. 25% iLUC factor for 170 GJ/ha/yr (SRC/SG) = 29 g/$MJ_{biofuel}$**

*= maximum case not 100% of theoretical iLUC factor as – conservatively estimated - 25% of all biofuel feedstocks will come from yield increases (average 1% per year until 2030)

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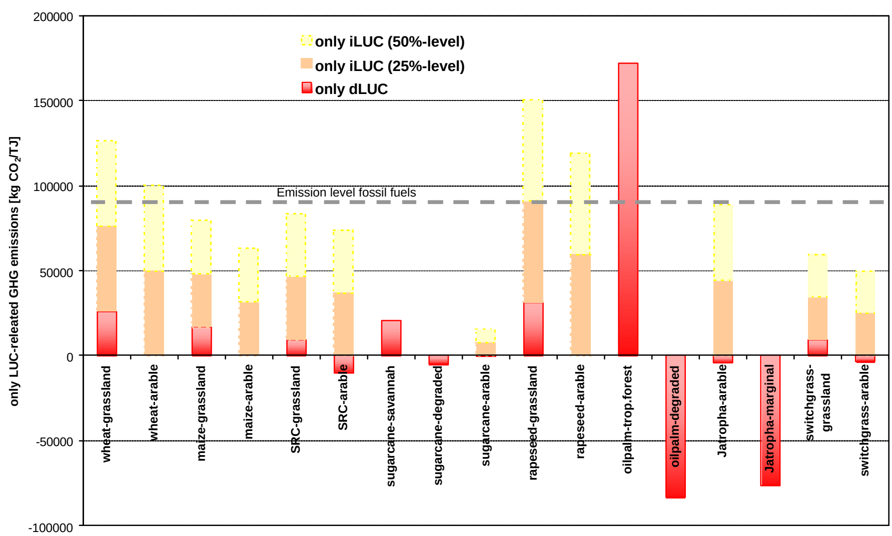
Direct + Indirect GHG from LUC



Data only for LUC-induced GHG emissions, excluding life-cycles

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Indirect GHG: "iLUC Factor"

Accounting for CO_2 from indirect LUC using the "iLUC factor" to extend life-cycle GHG balance of biofuels*

	kg CO_{2eq}/GJ with iLUC factor			relative to fossil diesel/petrol		
Biofuel, incl. allocation	**max**	**med**	**min**	**max**	**med**	**min**
Rapeseed to RME, EU	260	188	117	201%	118%	35%
Palm oil to PME, Indonesia	84	64	45	-3%	-25%	-48%
Sugar cane to EtOH, Brazil	48	42	36	-44%	-52%	-59%
Corn to EtOH, USA	129	101	72	50%	17%	-16%
Wheat to EtOH, EU	144	110	77	67%	28%	-11%
SRC/switchgrass to BtL, EU	109	75	42	26%	-13%	-51%

Source: own calculations

SRC = short-rotation coppice; BtL = biomass-to-liquid, i.e. Fischer-Tropsch synthetic diesel

*= By-product allocation using lower heating value; only arable land assumed (dLUC = 0 or negative for SRC); iLUC factor is zero for residues/wastes and for biocrops from unused/degraded lands

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Which dLUC for iLUC?

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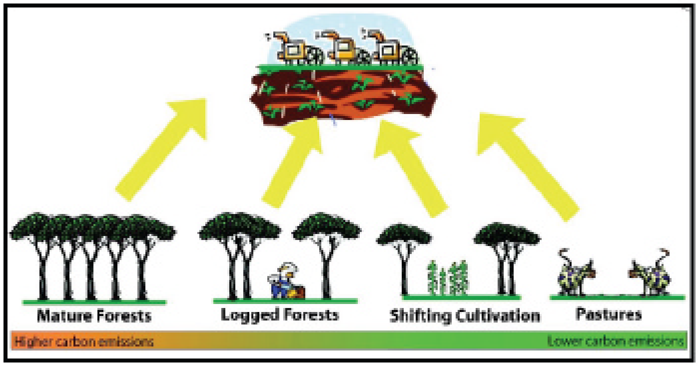
What are the sources for *new* croplands?



Largely undocumented across the tropics

Source: "Mapping Land Sources for New Biofuel Croplands" **Holly K. Gibbs,** Food Security and Environment Program, Stanford University, presented at the AAAS Annual Meeting, Feb. 14, 2009

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Which dLUC for iLUC?

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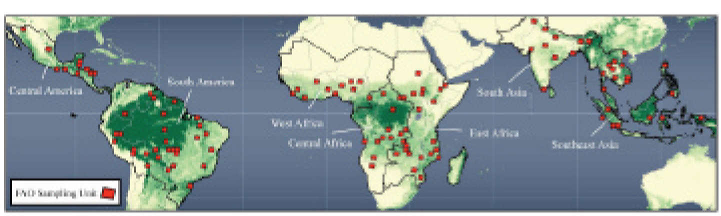
Analyzed library of Landsat images from FAO

→ Detailed satellite data with 30m by 30m spatial resolution



- Random sample of Landsat locations or "sites"
- "Snapshots" of land cover for 1980, 1990 and 2000

Source: "Mapping Land Sources for New Biofuel Croplands" **Holly K. Gibbs,** Food Security and Environment Program, Stanford University, presented at the AAAS Annual Meeting, Feb. 14, 2009

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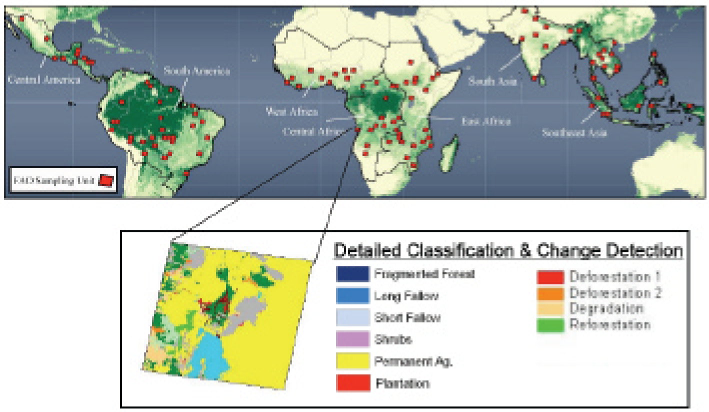
Which dLUC for iLUC?

Used Landsat to track agricultural expansion

→ Detailed satellite data with 30m by 30m spatial resolution



Source: "Mapping Land Sources for New Biofuel Croplands" **Holly K. Gibbs,** Food Security and Environment Program, Stanford University, presented at the AAAS Annual Meeting, Feb. 14, 2009

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Which dLUC for iLUC?

- Most agricultural land originated from forests

  Roughly 50% of new cropland replaced forests, and another 30% replaced disturbed forests

- 6% more forest was cleared for cropland in 1990s, likely due to mounting economic incentives

- Documented trends leading to increasing carbon emissions from agricultural expansion

Source: "Mapping Land Sources for New Biofuel Croplands" **Holly K. Gibbs,** Food Security and Environment Program, Stanford University, presented at the AAAS Annual Meeting, Feb. 14, 2009

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Further Work

- Derive **2010 estimate** for iLUC factor (late 2009)
- Better understanding of dLUC characteristics of displacement: e.g., Gibbs (2009) mapping of past LUC (1980-2000) → revise iLUC factor?
- “**Risk mapping**“: identify potential countries/areas under thread of iLUC using CGE model results (GTAP etc.) + suitability maps + infrastructure + biodiversity/carbon maps (Oeko-Institut case studies in BR, CN, IN, ZA)
- More research **beyond EU** (with UNEP, GBEP): include developing countries views

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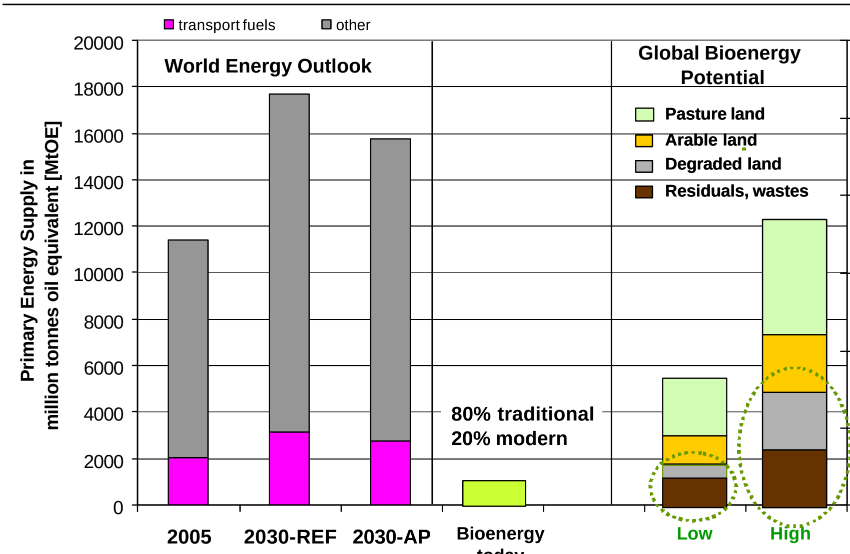
Low-iLUC Biomass Potentials



→ Key role of agriculture productivity to “free“ land

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Conclusions

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- Indirect LUC: **all incremental biomass** – electricity, heat, transport, biomaterials, food, feed, fiber…
- Definition + mapping of degraded land + biodiversity: 2nd Joint Int. Workshop July 7-8, 2009 in Paris @ UNEP
- Use "degraded" land → higher costs, **incentives needed** (RES-D bonus, REDD) + biodiv/social safeguards
- **Investor alliance** for sustainable supply: build on country study results (late 2009) to bundle investment in degraded land + infrastructure "overhead"; incentives for zero-iLUC supply from govmts?
- Long-term: strengthen **global conventions** (FCCC, CBD) to **"cap"** iLUC effects on GHG and biodiversity
→ only **real** solution!

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More Information

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