Compétition pour l'utilisation du sol

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Plan

Global land use & Land use competition

Supply-side possibilities:

- **Expansion on “low-cost” land**
- **Land use intensification**
- **Land use policies, forest transitions and land use displacement**

Conclusion and further approaches

Status and trends of global land use

Current state of global land use

Main land uses in 2000	Mha (low-high)	% ice-free land (low-high)
Urban and built-up	66 - 73	0.5 - 0.6
Agriculture (cropland & pastures)	4,310 – 5,286	33.1 - 40.5
Forests under use (natural and planted)	2,652 – 2,941	20.3 - 22.6
Other land under use (unforested)	1,018 – 2,813	7.8 - 21.6
Wilderness and unproductive land	3,199 – 3,722	24.5 - 28.5

Adapted from Lambin and Meyfroidt 2011, 2014, Luyssaert et al. 2014

The future of land use

- Growing demand for agricultural and forestry products

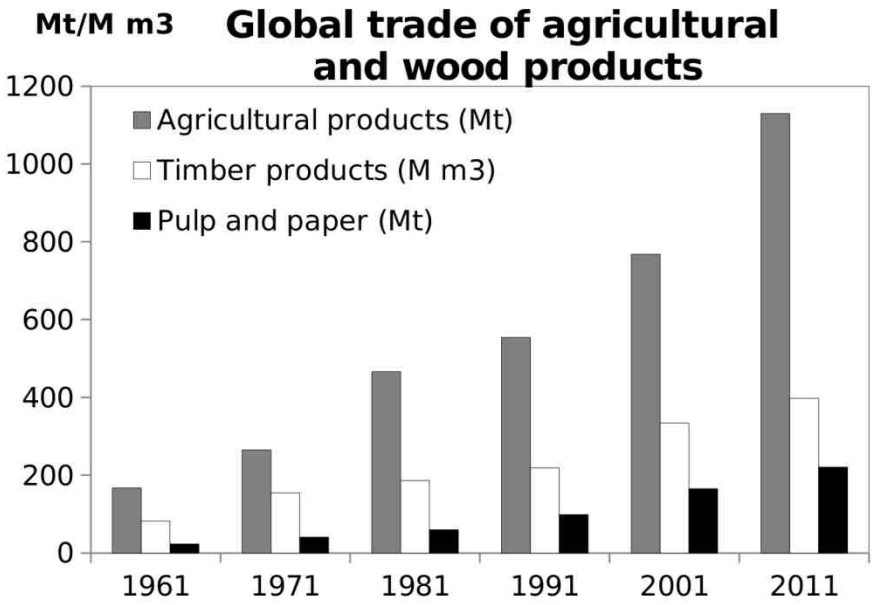
  → Food production +100%, forestry products up to +55% over 2005-2050 (Tilman et al. 2011, Smeets et al. 2007); + biofuels…

- Where, how, at what costs?

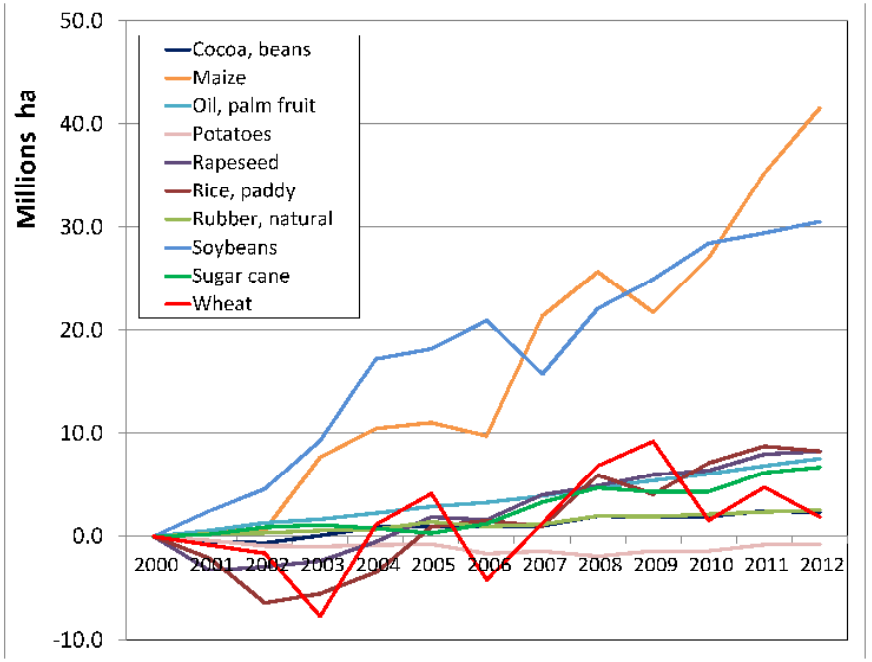
Projected land use change over 2000-2030 (Mha):
Additional cropland: 81-147
Additional biofuel crops: 44-118
Additional grazing land: 0-151
Urban expansion: 48-100
Additional industrial forestry: 56-109
Total land demand: **303-845 Mha**

Lambin and Meyfroidt 2011, Lambin and Meyfroidt 2014

Increasing international trade of agricultural and forestry products



Rise of a few commodity crops

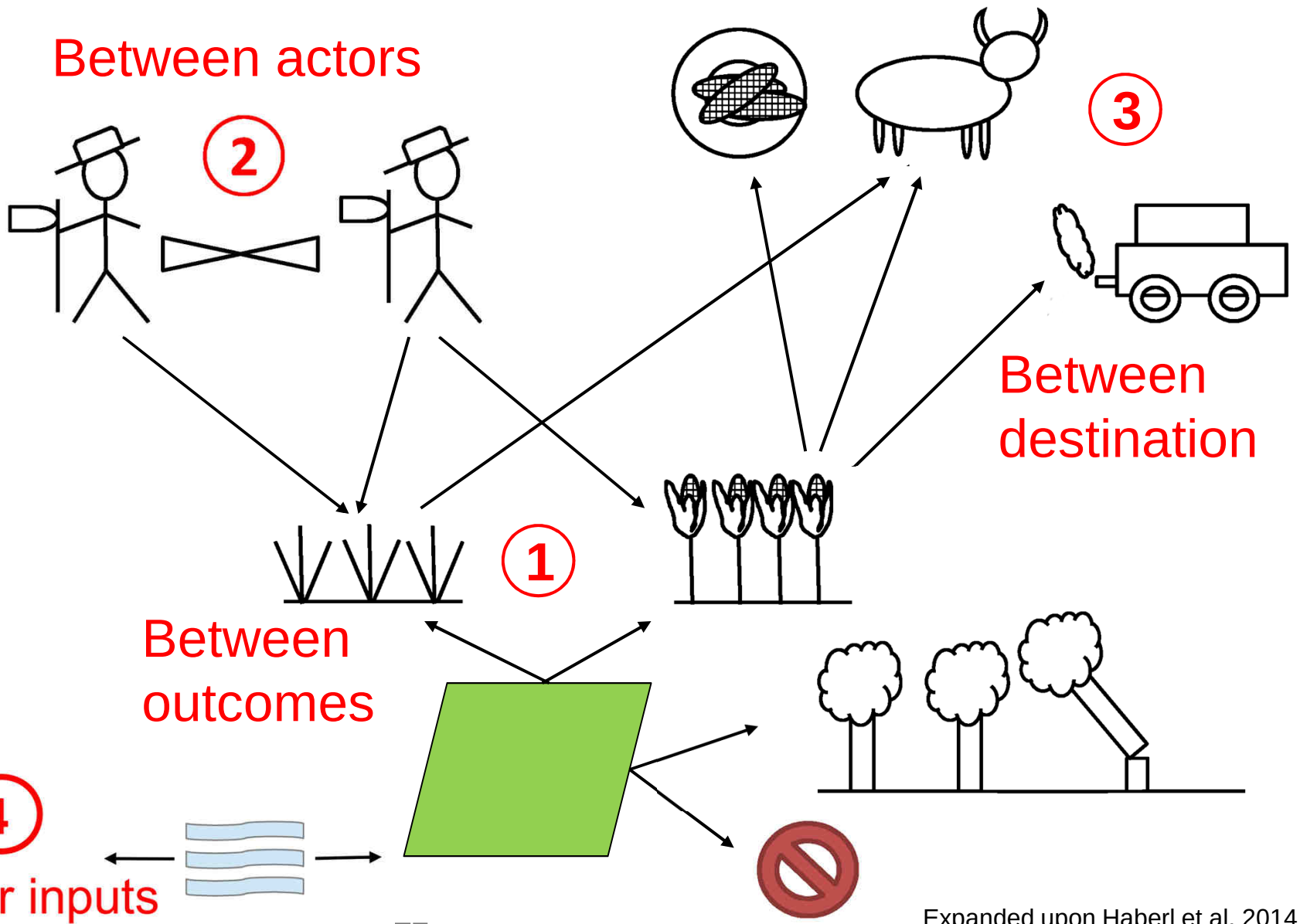


5 → 10% of agricultural production

~24% of land used

FAOSTAT

Land use competition



Expanded upon Haberl et al. 2014

Dominant structural trends in land use competition

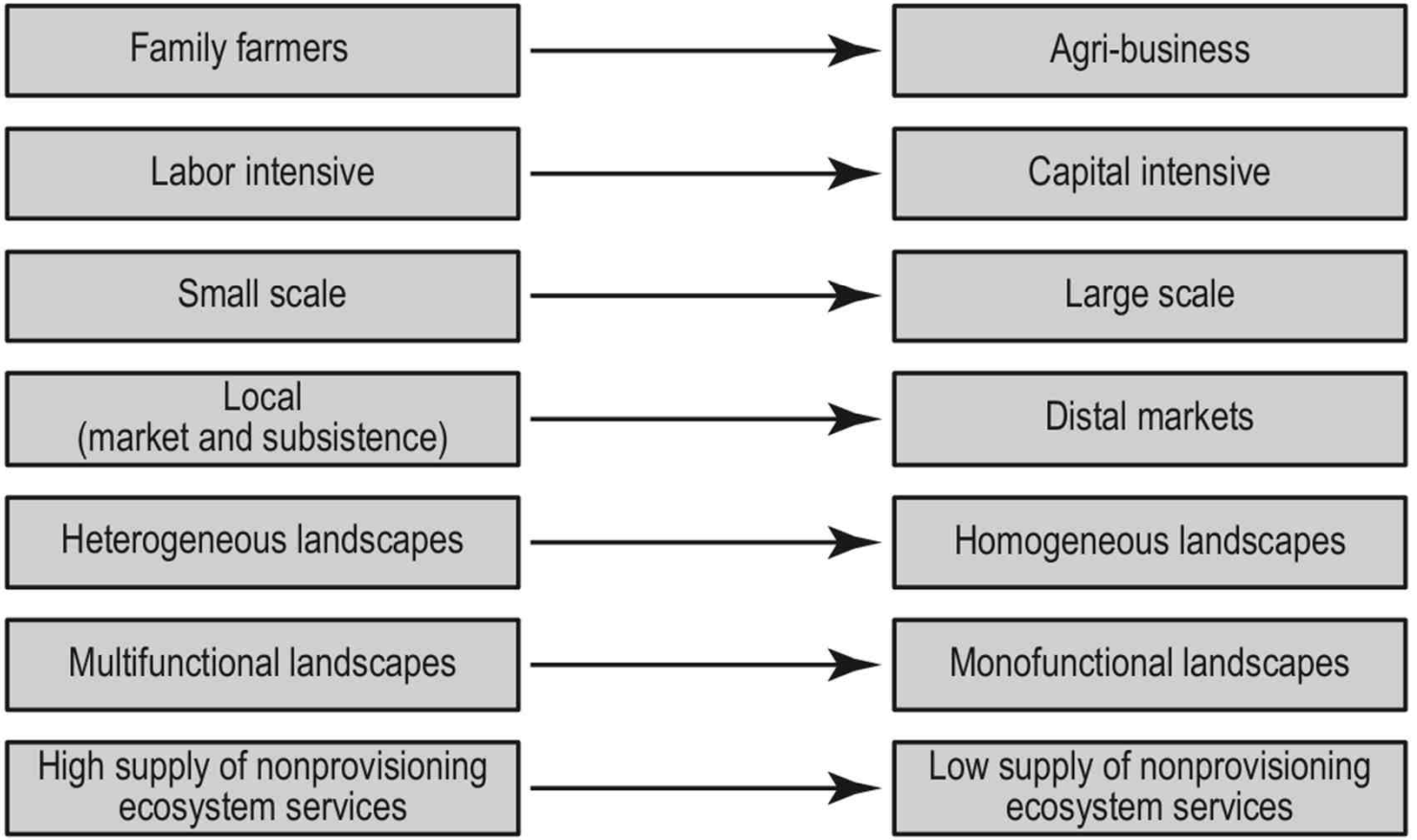
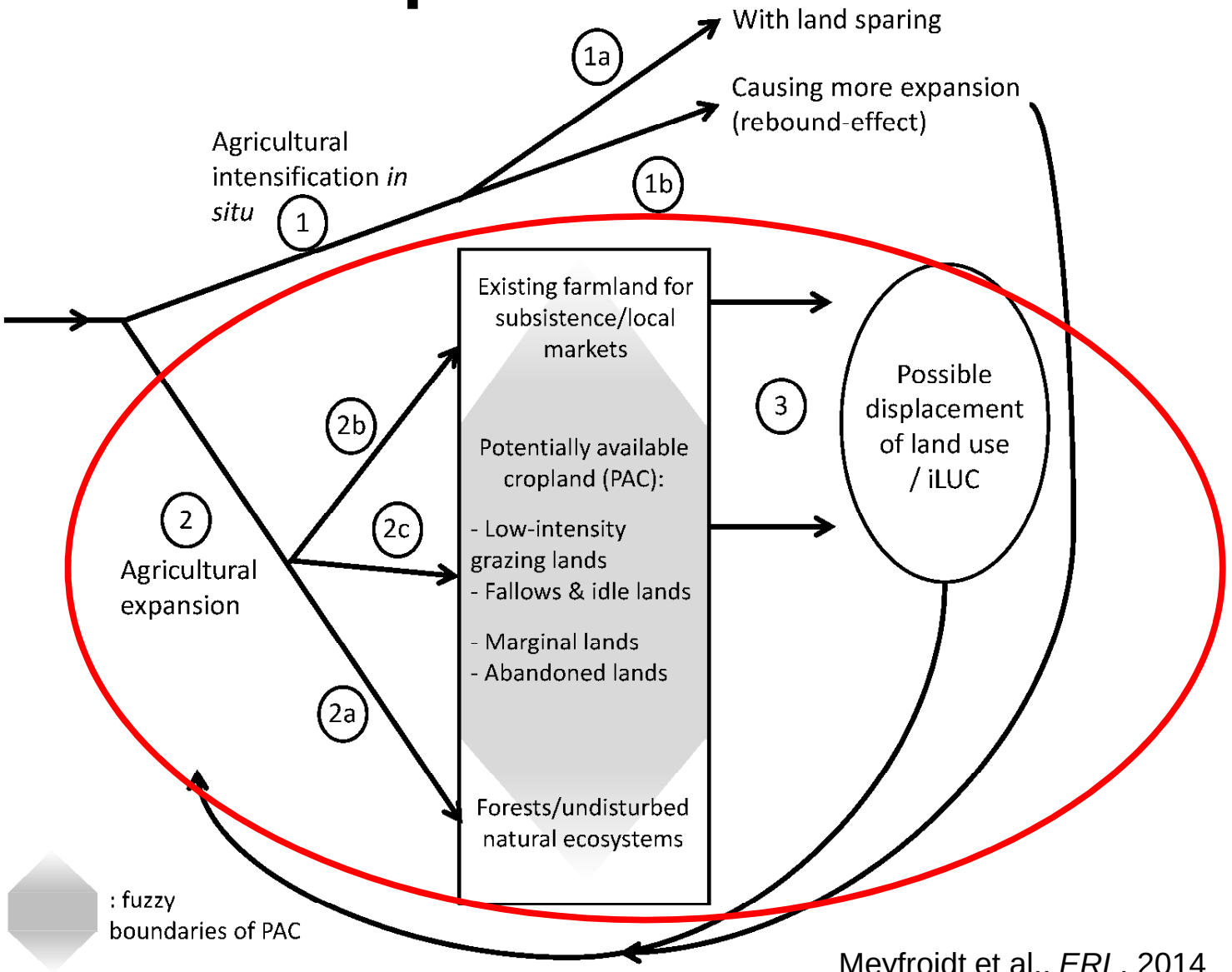


Figure 4.2 Dominant trends in structural changes in agricultural and forestry systems.

Haberl et al. 2014 in *Rethinking Global Land Use in an Urban Era*, MIT Press.

Expansion of commodity crops on “low-cost” land

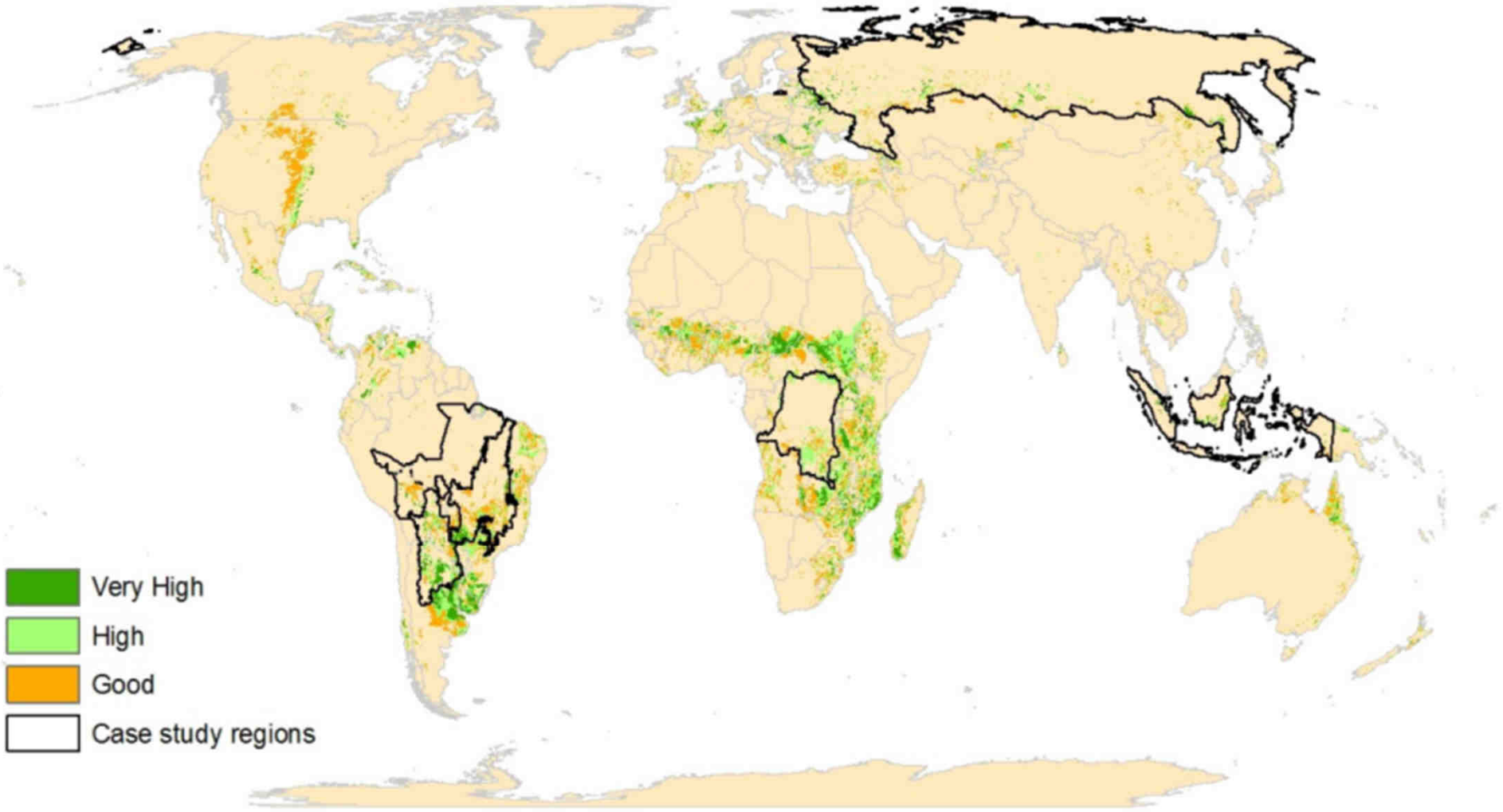
Pathways of increase of commodity crop production



Meyfroidt et al., *ERL*, 2014

UCL

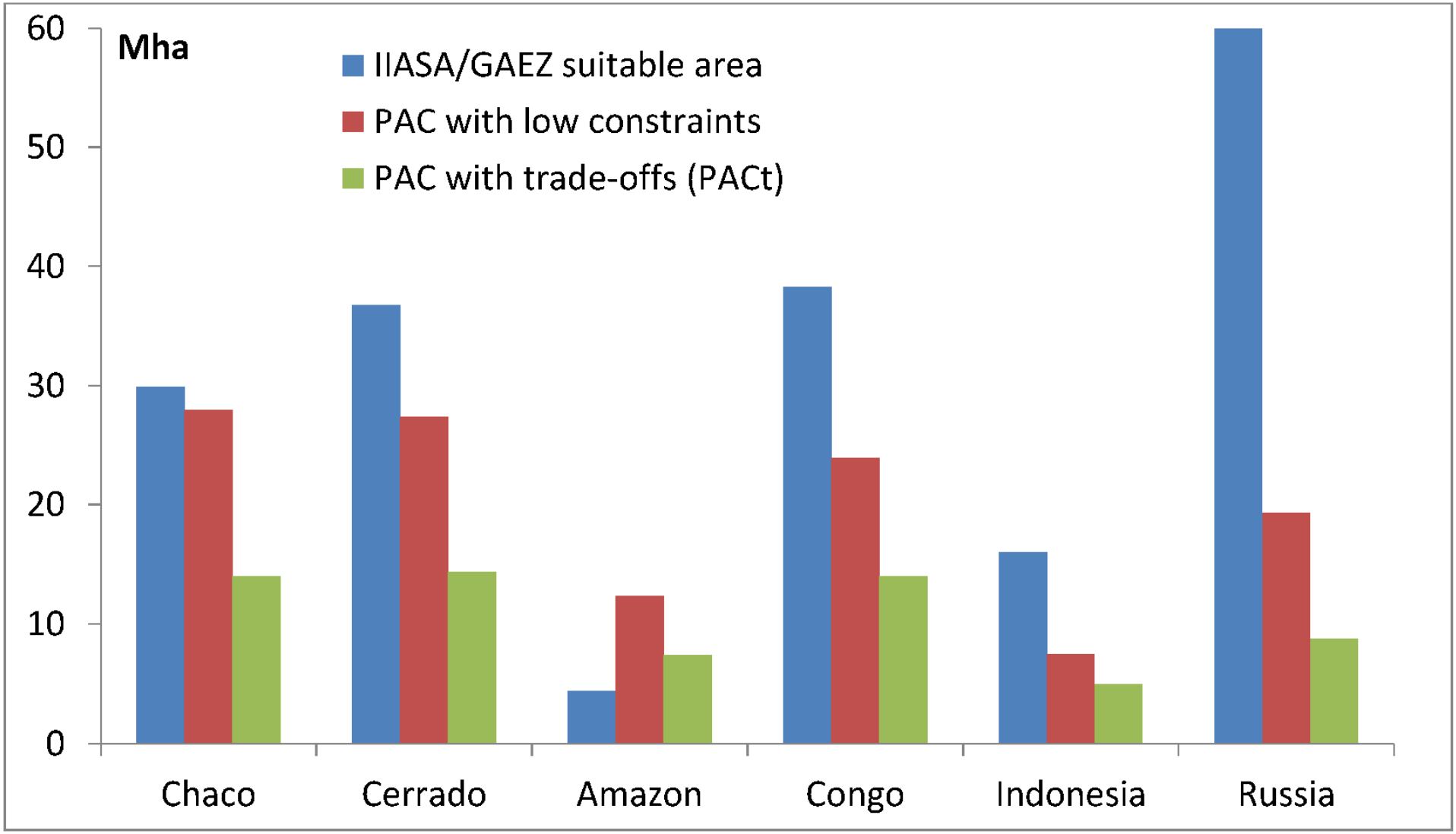
Potentially available cropland



GAEZ: 30% of the current cropland area

Lambin et al. 2013, *Global Environ. Chang.*

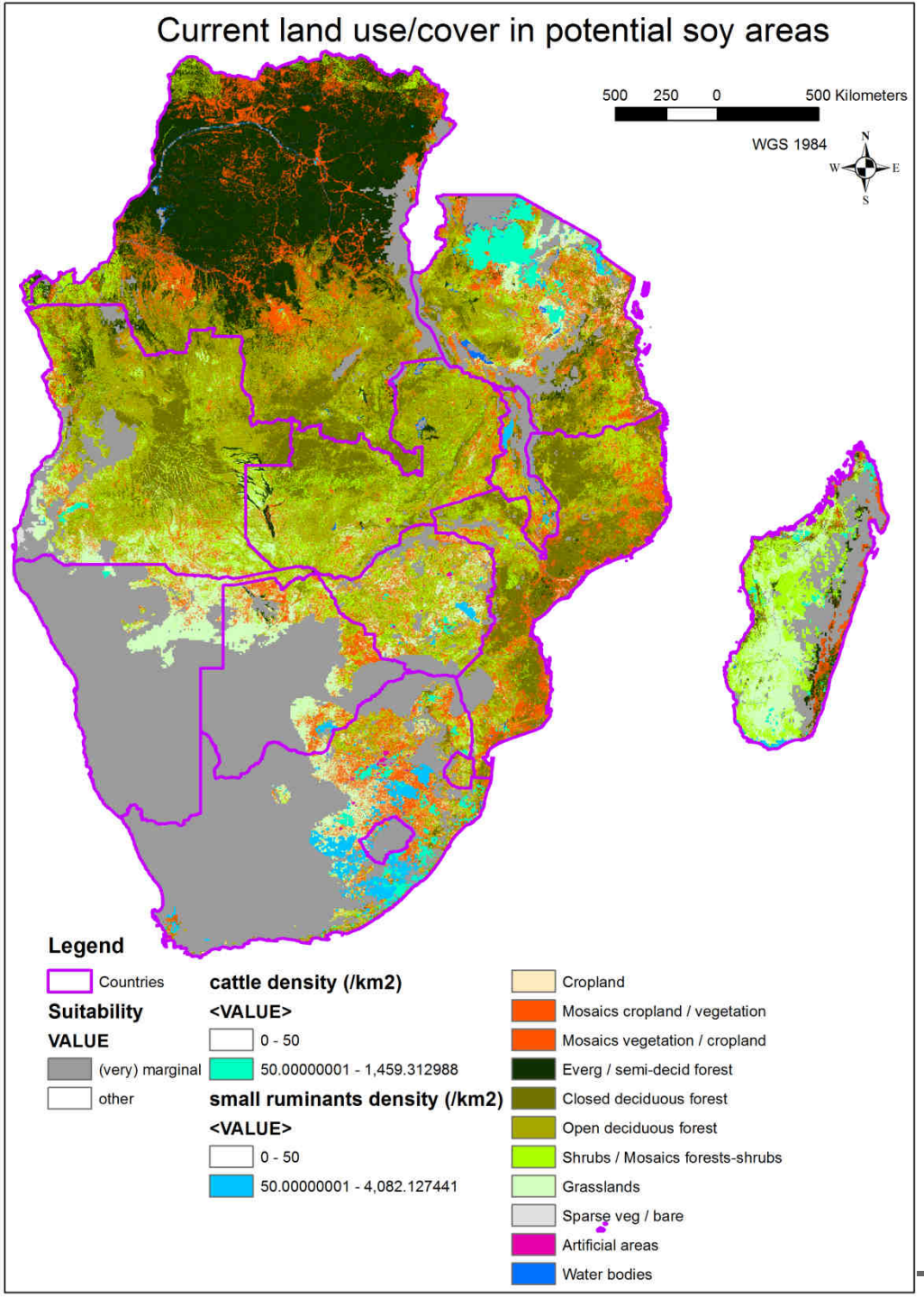
Potentially available cropland



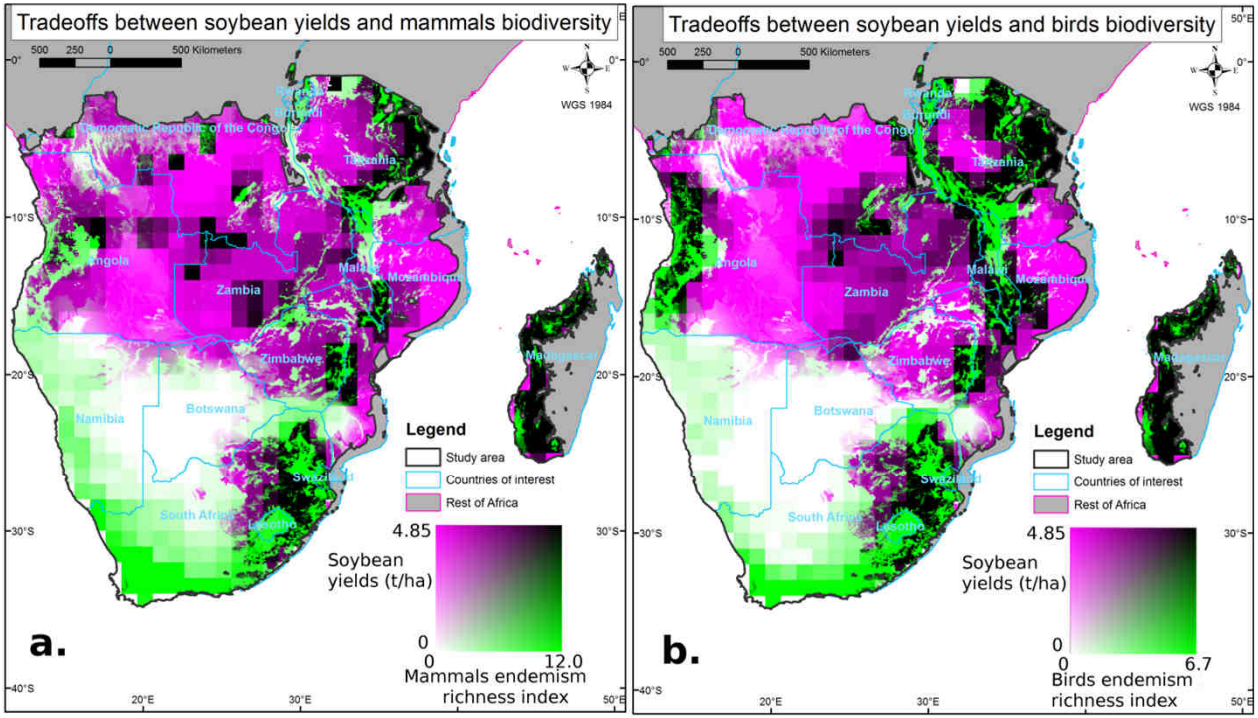
GAEZ: 185.7 Mha vs PACt: 57.5 - 69.7 Mha (**31-37%**)

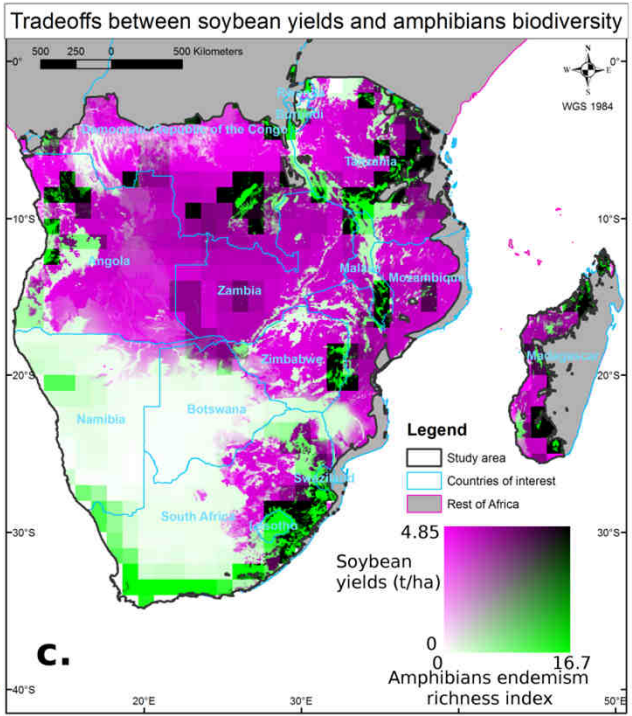
Adapted from Lambin et al. 2013, *Global Environ. Chang.*

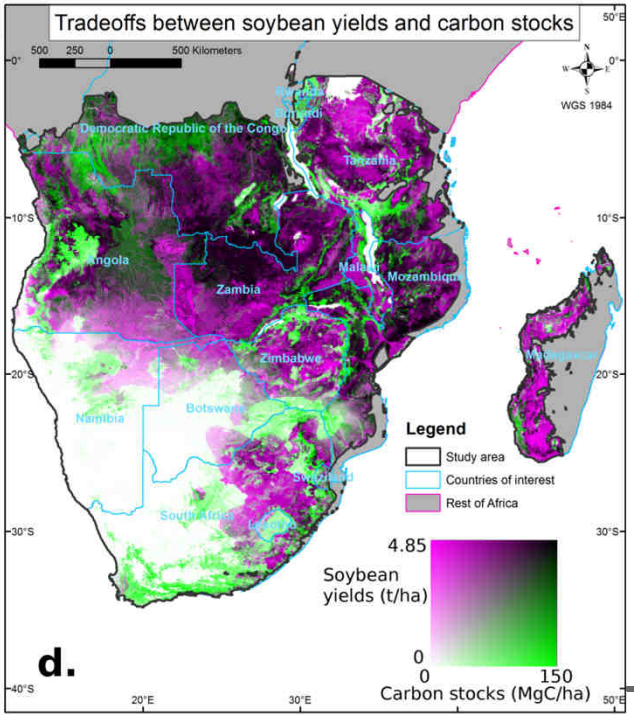
Southern Africa



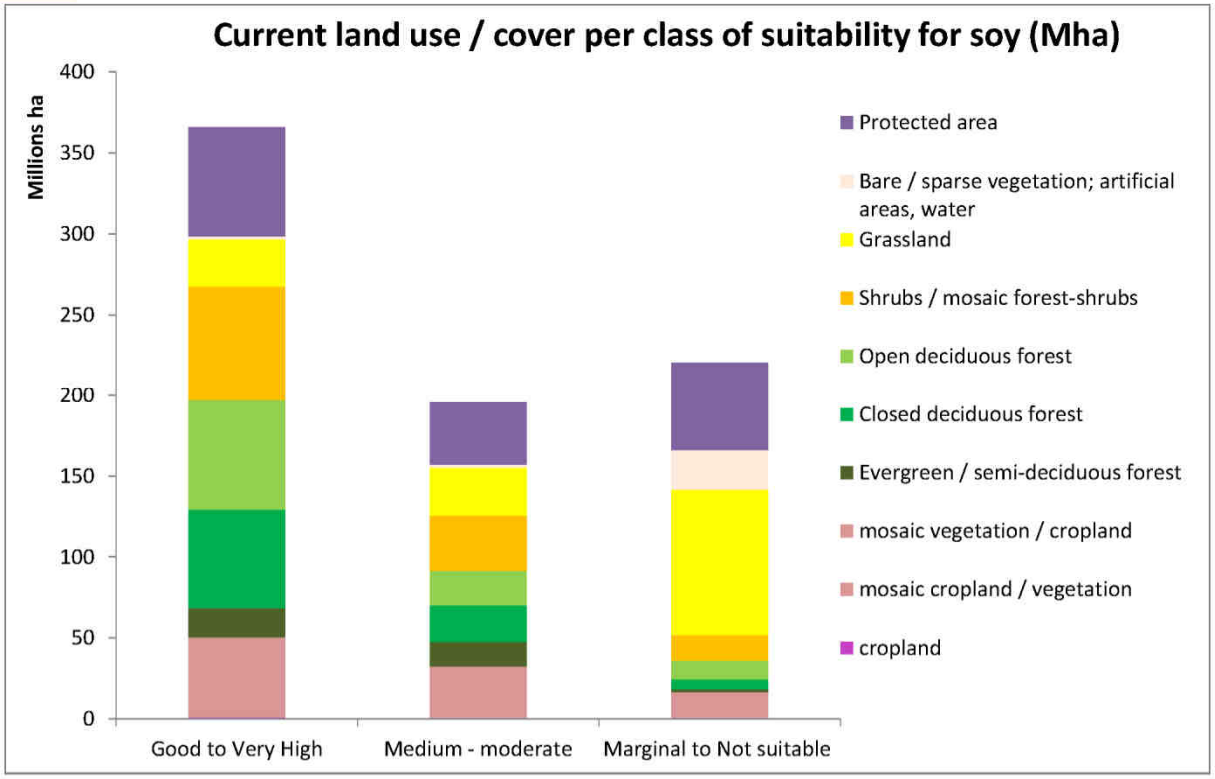
Gasparri et al.
under revision

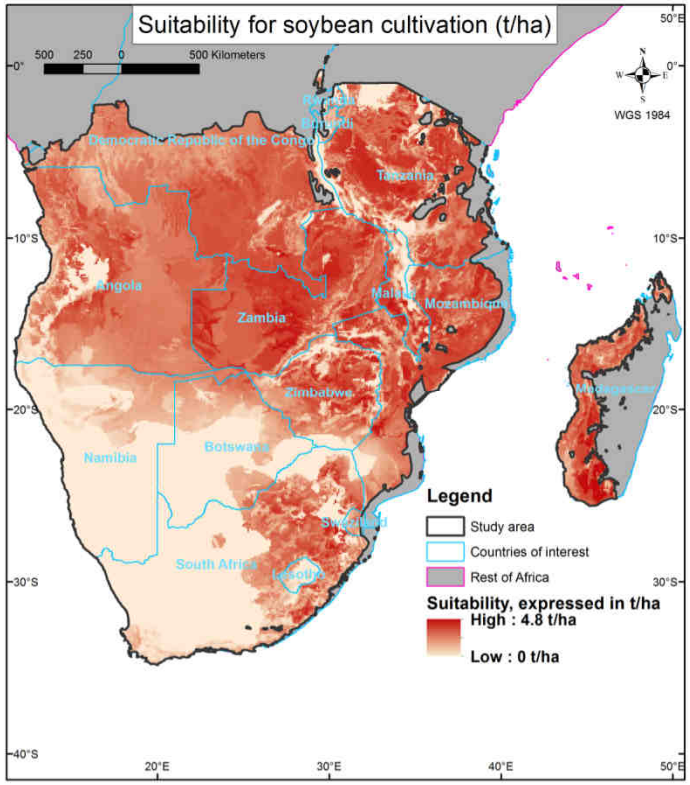






Gasparri et al.
under revision



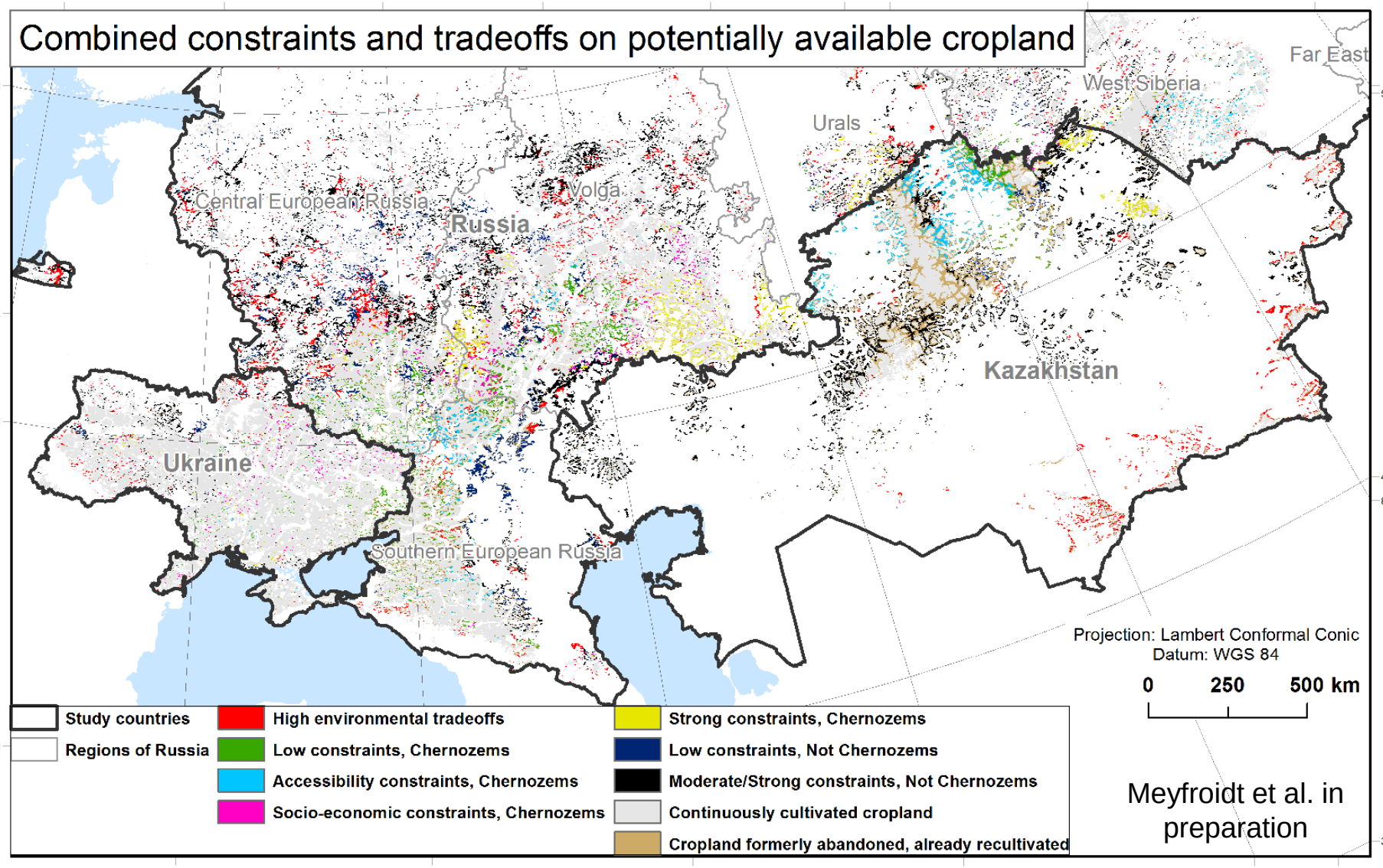


365 Mha with good to very high suitability, of which:

* 50 Mha are cropland mosaics
* 67 Mha are protected areas
* 80 Mha with a cattle density > 10 heads/ha

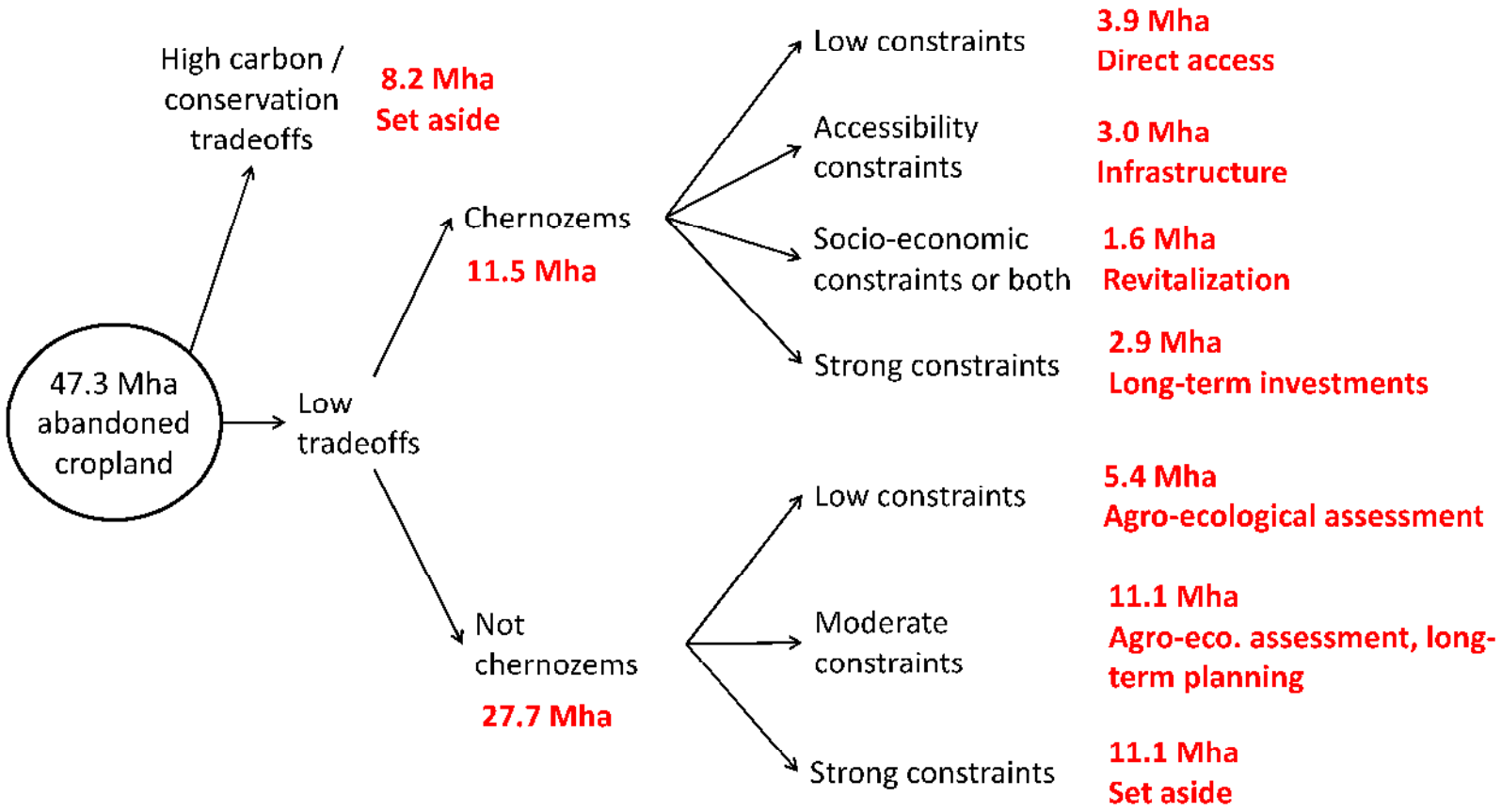
Gasparri et al.
under revision

Former Soviet Union: Russia, Ukraine, Kazakhstan



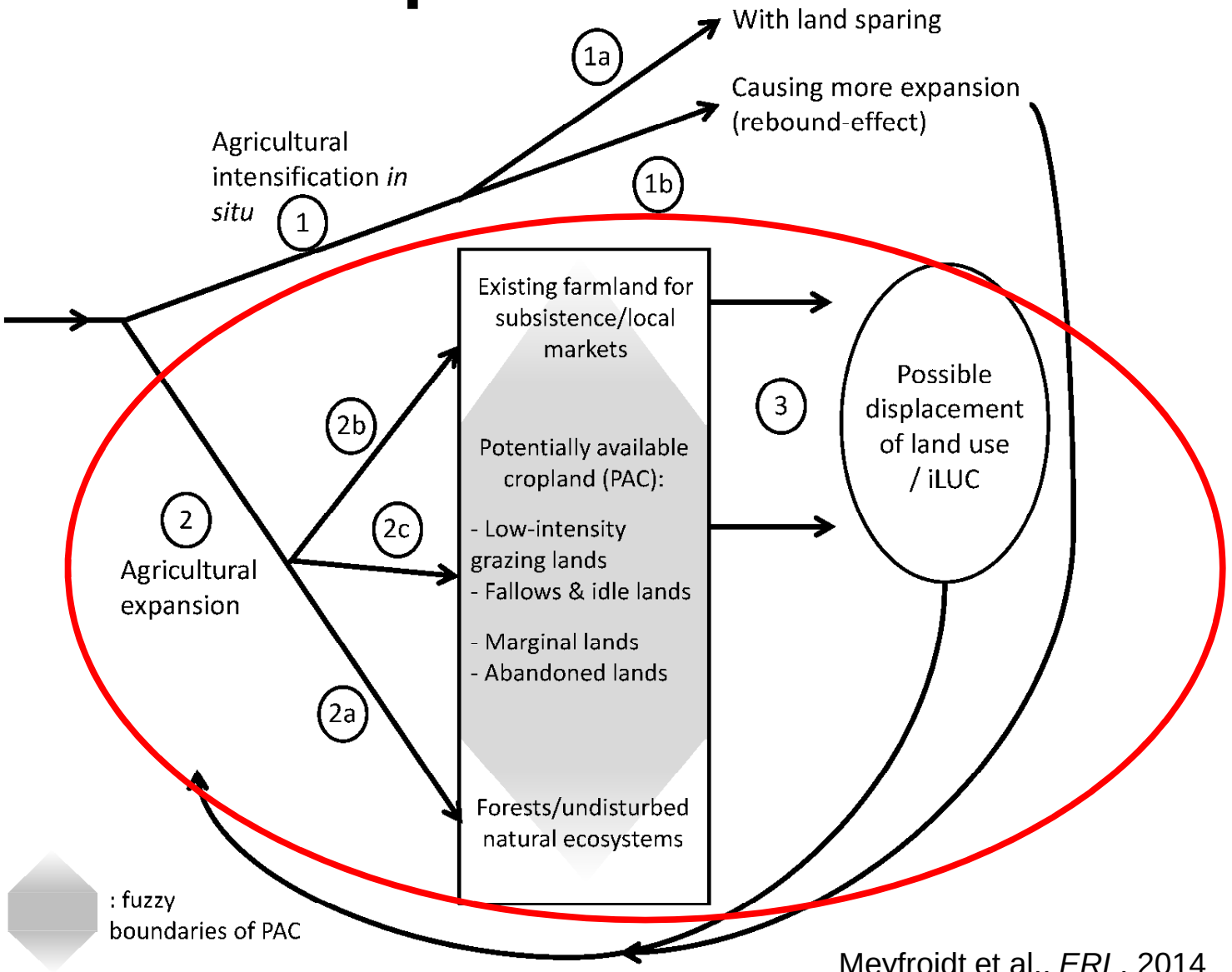
Russia, Ukraine, Kazakhstan

a.



Meyfroidt et al. in preparation

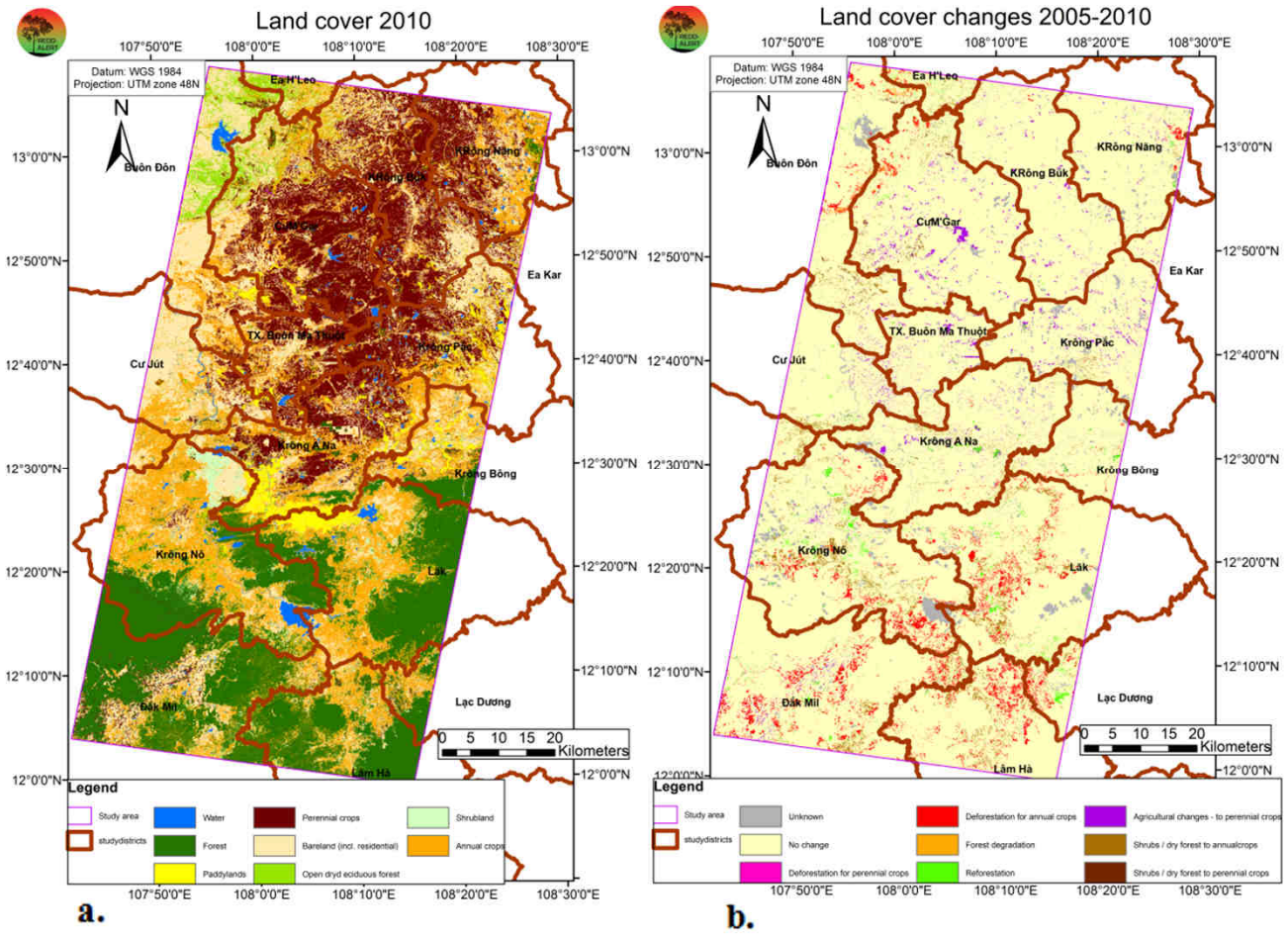
Pathways of increase of commodity crop production



Meyfroidt et al., *ERL*, 2014

UCL

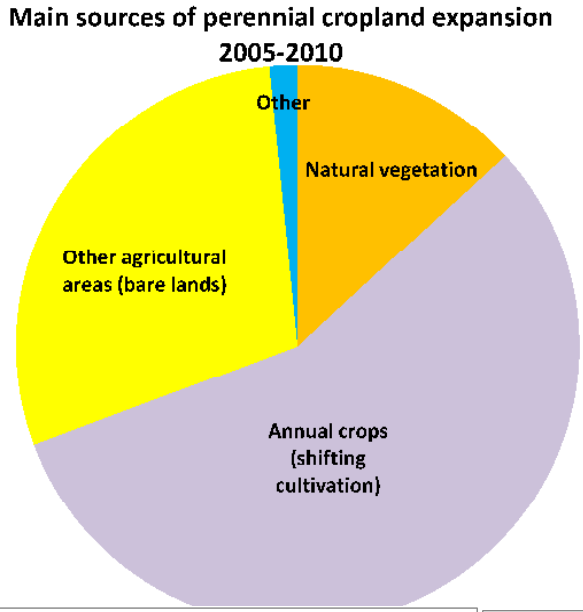
Vietnam Central highlands

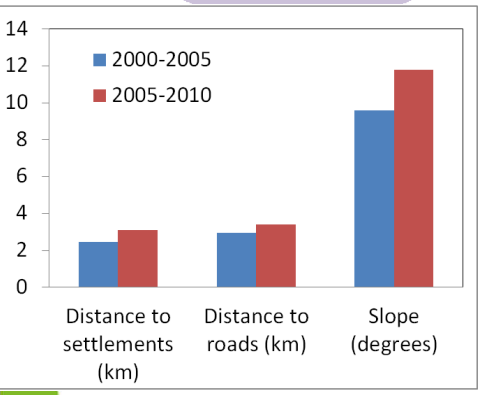


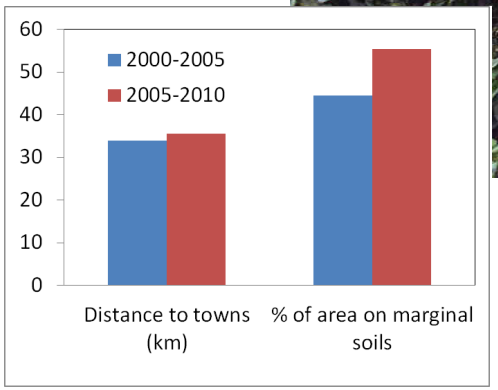
→ Direct cause of deforestation: annual crops (shifting cultivation)

Meyfroidt et al. 2013, *Global Environ. Chang.*, doi: 10.1016/j.gloenvcha.2013.04.005

Vietnam Central highlands







→ Coffee expansion over agricultural lands
→ Shifting cultivation over marginal & remote areas
→ Displacement of poor/ethnic minorities households (iLUC).

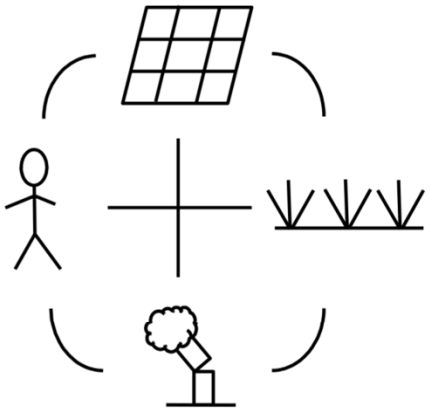
Meyfroidt et al. 2013, *Global Environ. Chang.*, doi: 10.1016/j.gloenvcha.2013.04.005

Main factors

Main factors controlling pathways of commodity crop expansion in tropical forest landscapes

LANDSCAPE
Availability of forestland versus other land pools:
- Physical availability
- Agro-ecological potential
- Accessibility
- Land use policies

ACTORS
Differences in constraints and opportunities between small and largeholders:
- Sizes of land holdings targeted to reach economies of scale
- Transaction costs and conflicts associated with land consolidation
- Capital versus labor constraints, including for clearing forests
- Capacity to negotiate with public authorities
- Capacity to establish and enforce property rights
- Capacity to establish infrastructures
- Responsiveness to governance instruments



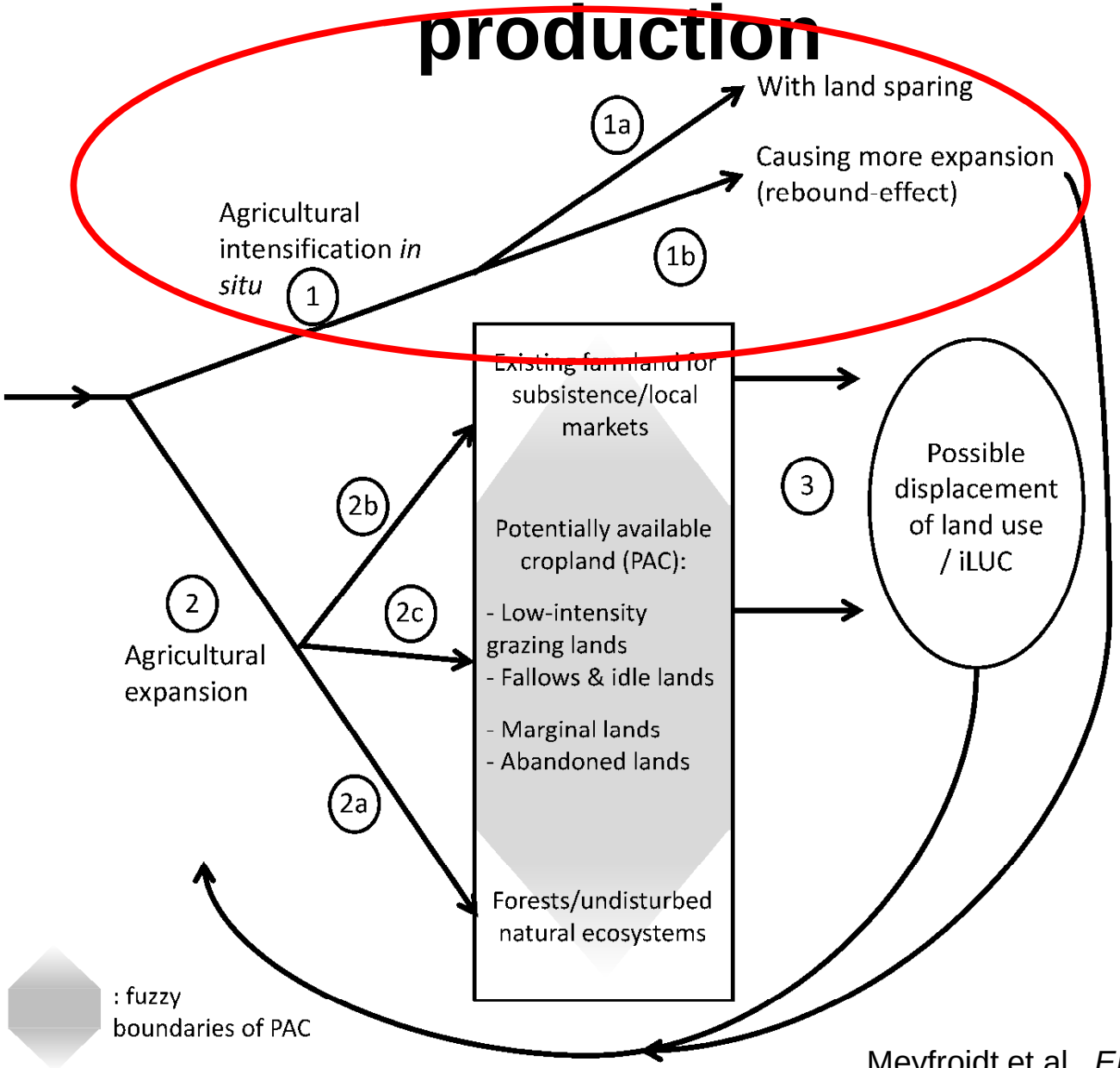
LAND USE / AGRICULTURAL SYSTEMS
Relative characteristics of the different land uses:
- Export orientation
- Accessibility requirements
- Infrastructures requirements
- Specific agro-ecological requirements
- Bid rent

FORESTRY / AGRICULTURE LINKAGES
Contextual factors affecting costs and benefits of forest clearing:
- Amount and quality of timber stocks in forests
- Market demand and prices for timber
- Integration between forestry and agricultural activities

Meyfroidt et al., *ERL*, 2014

Land use intensification

Pathways of increase of commodity crop production



Meyfroidt et al., *ERL*, 2014

Globalization and rebound-effect

- Intensification can **spare land** when

- Labor intensification when labor constraints
- Area expansion potential is limited
- Inelastic demand (staple products / closed markets)

Example: Vietnam – paddy rice intensification

- But **rebound-effect** when:

- Unconstrained labor (migration)
- Capital intensification (w. mobile capital flows)
- Income- and price-elasticity of demand – meat, leisure crops, bioenergy crops, especially with open markets
- Relatively low yields in intensification region

Lambin and Meyfroidt 2011
Angelsen and Kaimowitz 2001
Rudel et al. 2009
Hertel et al. 2014
Villoria et al. 2014
Byerlee et al. 2014

African Green Revolution

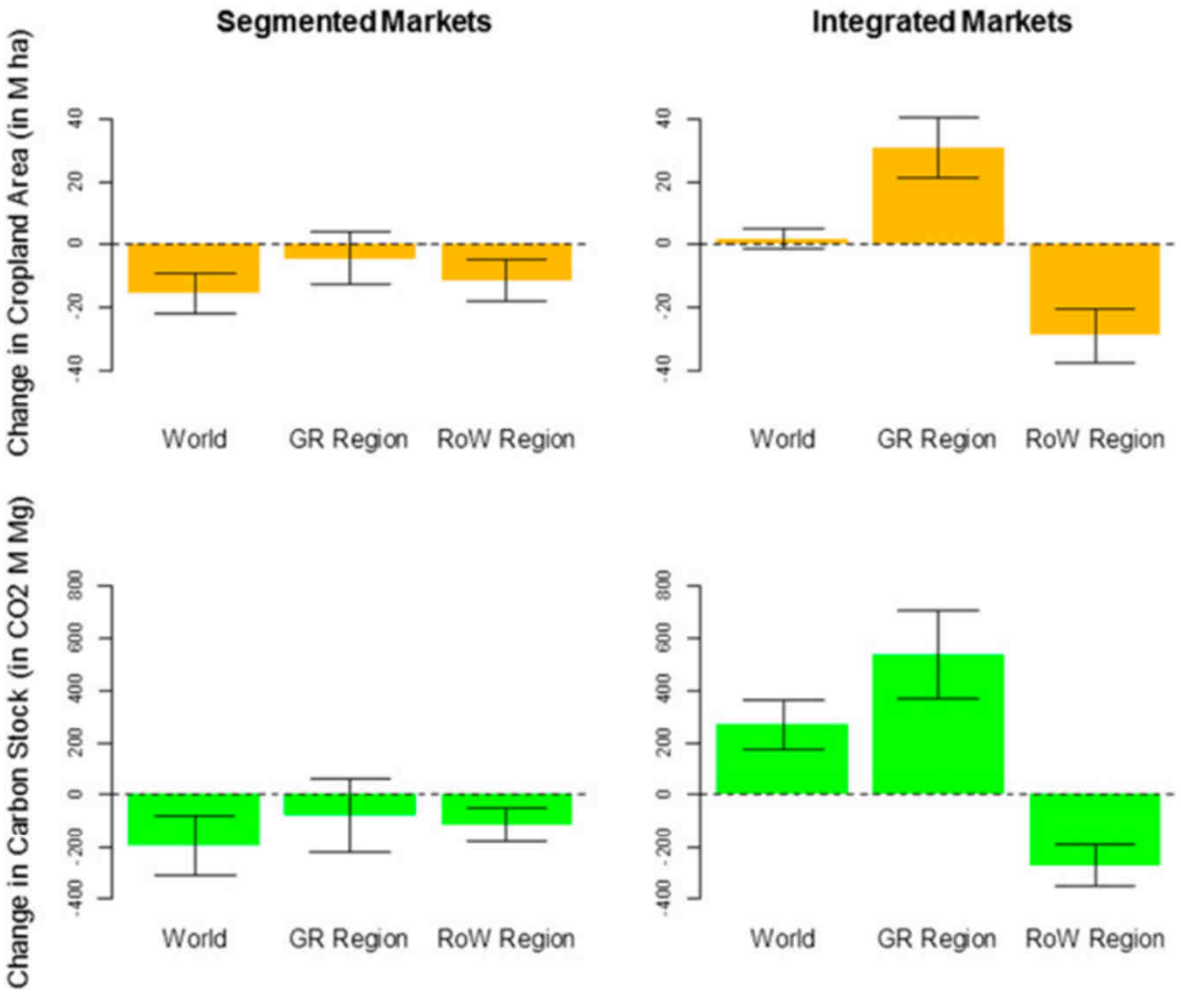
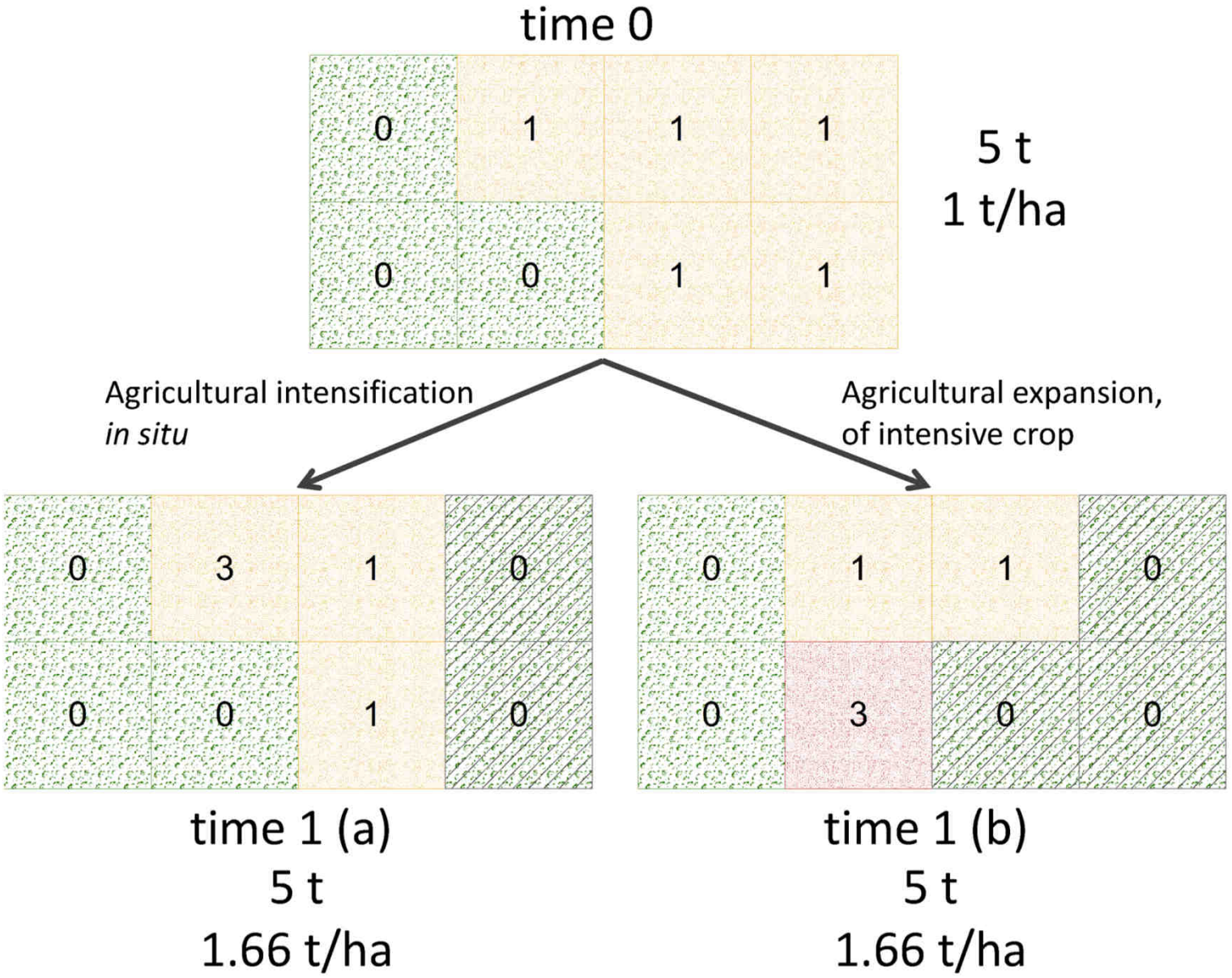


Fig. 3. Sensitivity analysis of the regional and global cropland change and their corresponding carbon emissions given a future African Green Revolution under both segmented and integrated markets: difference between with vs. without Green Revolution TFP growth. Error bars reflect 95% CIs obtained from Monte Carlo analysis with respect to parameter uncertainty.

Hertel et al. 2014 *PNAS*

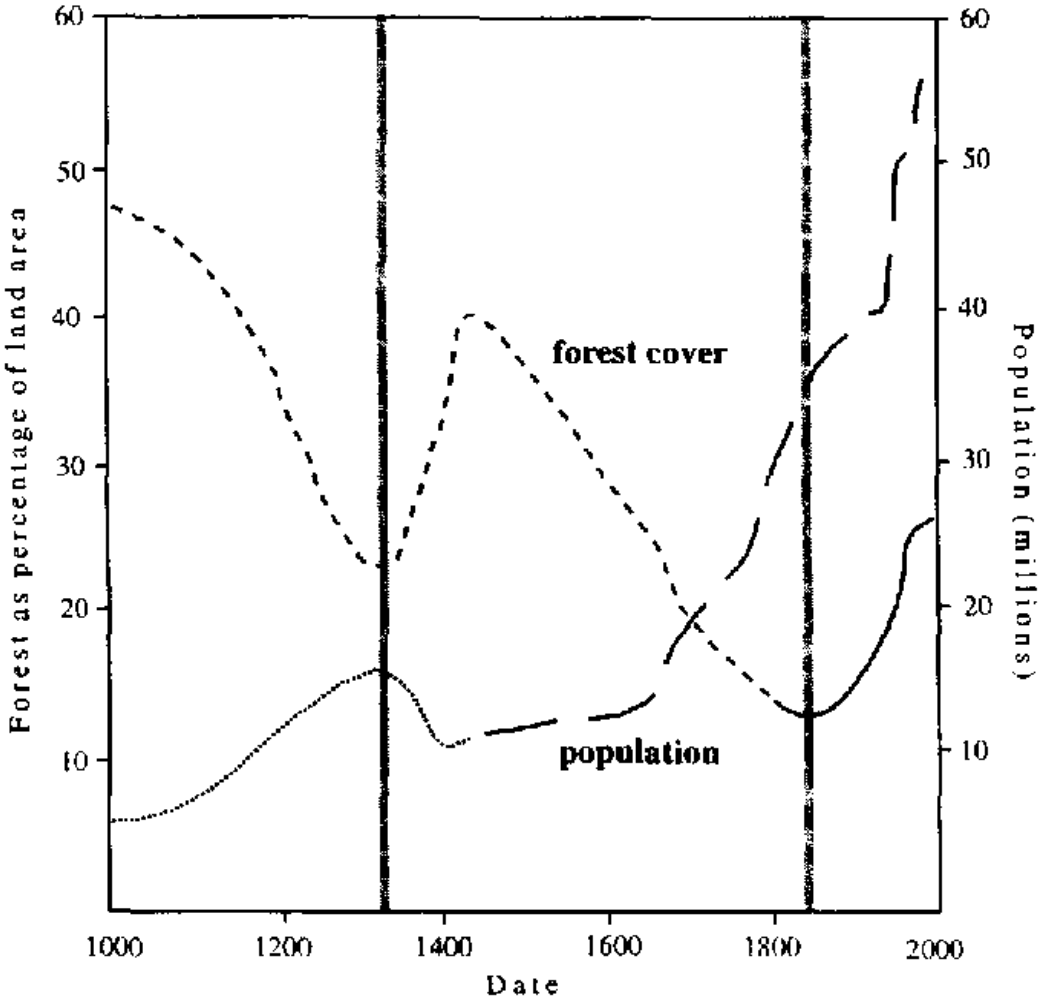
Pathways of land sparing



Meyfroidt et al., 2014, *ERL*

Land use policies, forest transitions and land use displacement

Forest transition in France



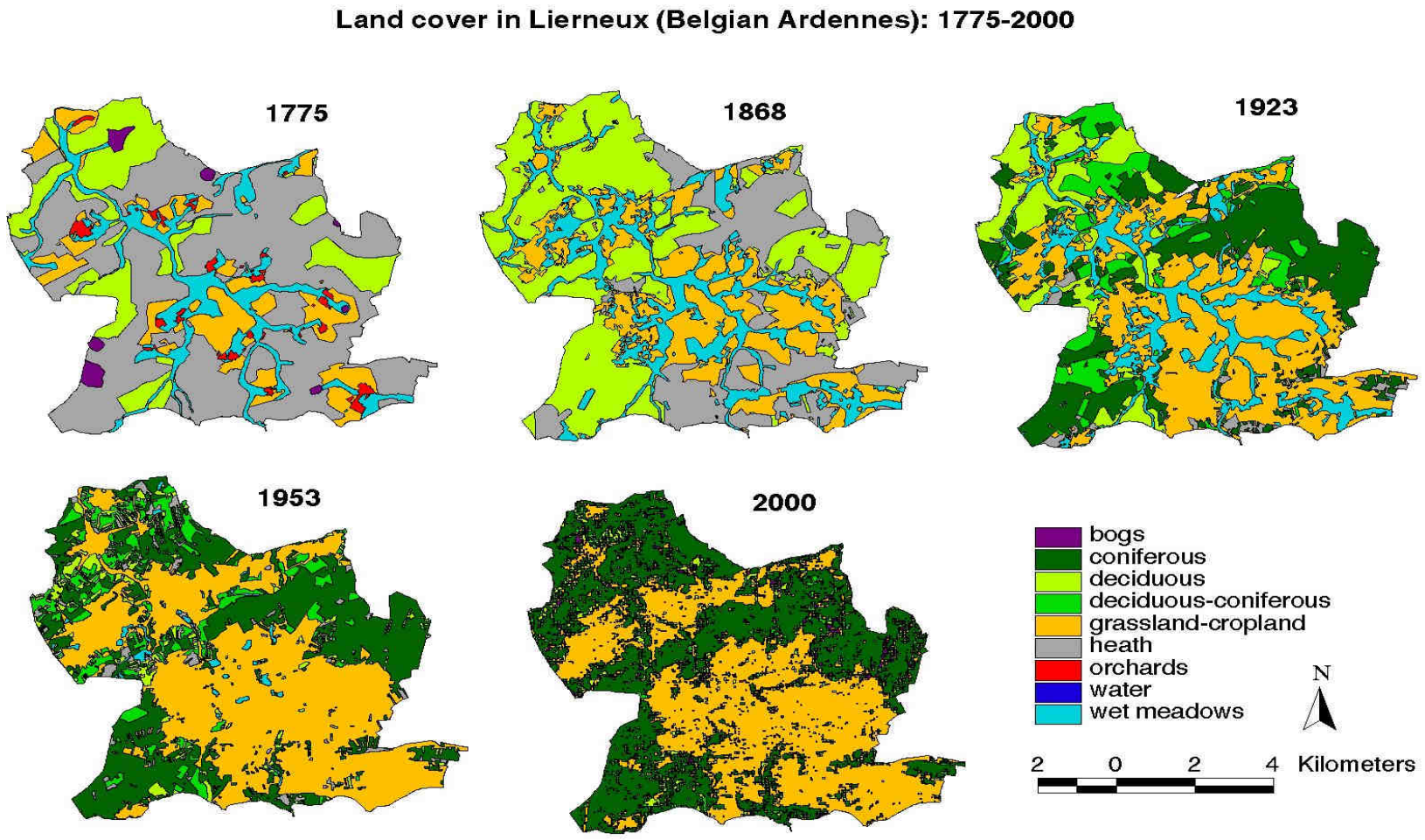
Mather et al. 1999

Turnaround in forest cover trend from deforestation to reforestation

Regional or national scale

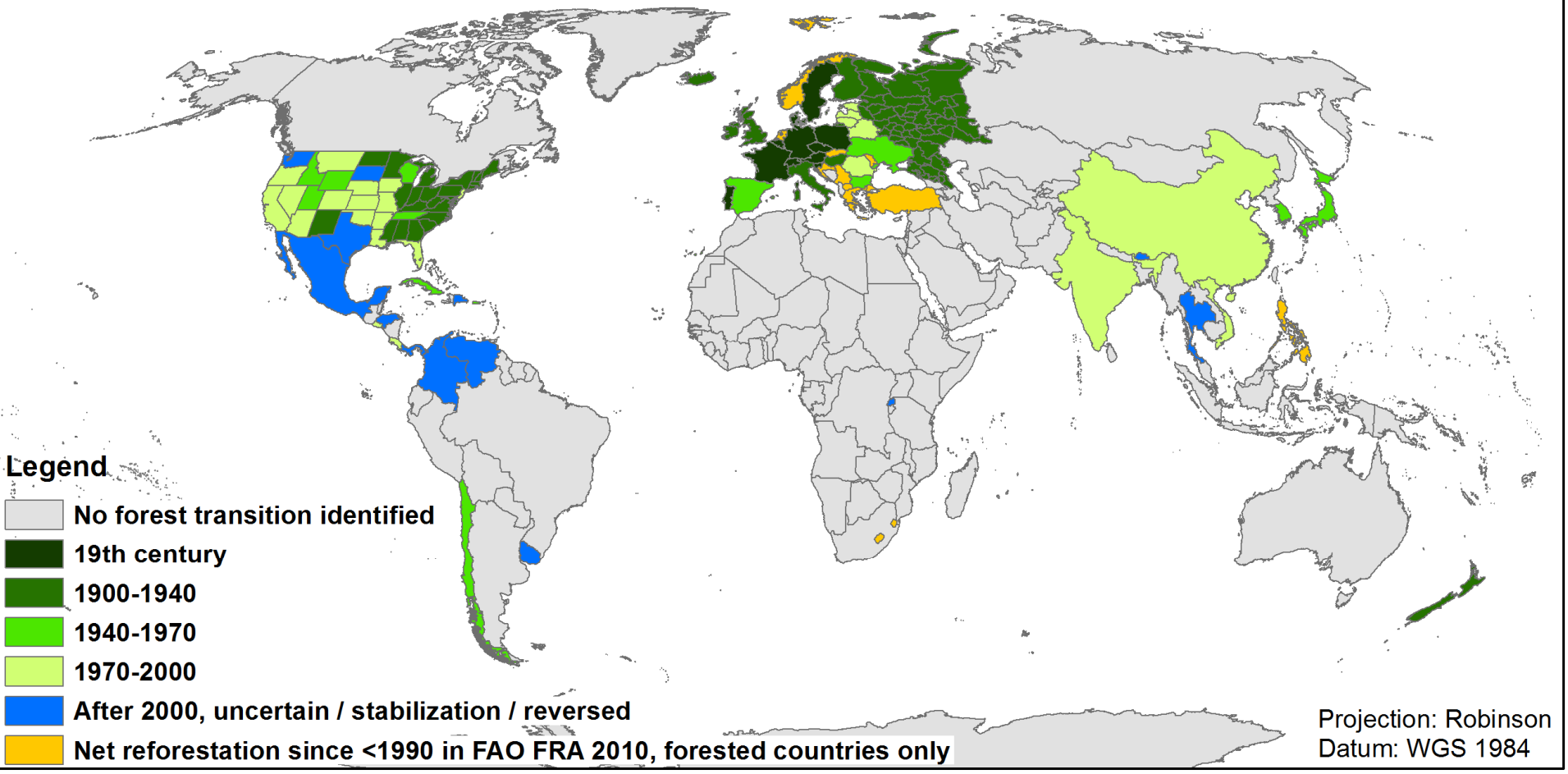
Long-term trend

Long-term land-cover change in a community of the Belgian Ardennes



Petit & Lambin, 2002

Periods of the described recent forest transitions and forest stabilization



Adapted and updated from Meyfroidt P, Lambin EF. 2011, *Annu Rev Environ Resour*

Pathways of forest transition

Economic development path:

Economic development creates enough non-farm jobs to pull farmers off of the land, thereby inducing the spontaneous regeneration of forests in old fields.

Agricultural intensification and markets developments allow food supply to increase and concentrate on the most productive land.

Forest scarcity path:

A scarcity of forest products and a decline in ecosystem services (e.g., floods) prompts governments and landowners to plant trees and protect remaining forests

Rudel et al. 2005

State forest policy path: Changes in national forest policies modify management practices on forests. Motivations:

- Modernize the economy
- Integrate marginal social groups
- Promote tourism or foreign investments
- Assert control over remote territories

Globalization path:

- Neo-liberal economic reforms: free trade, specialization
- Labour out-migration, remittances
- Growing tourism, land acquisition by expatriates
- Diffusion of nature conservation ideology

Lambin and Meyfroidt 2010;
Meyfroidt and Lambin 2011

Smallholder, tree-based land use intensification path:

Marginal regions with smallholder agriculture: landscape mosaics with “anthropogenic” or “domestic” forests

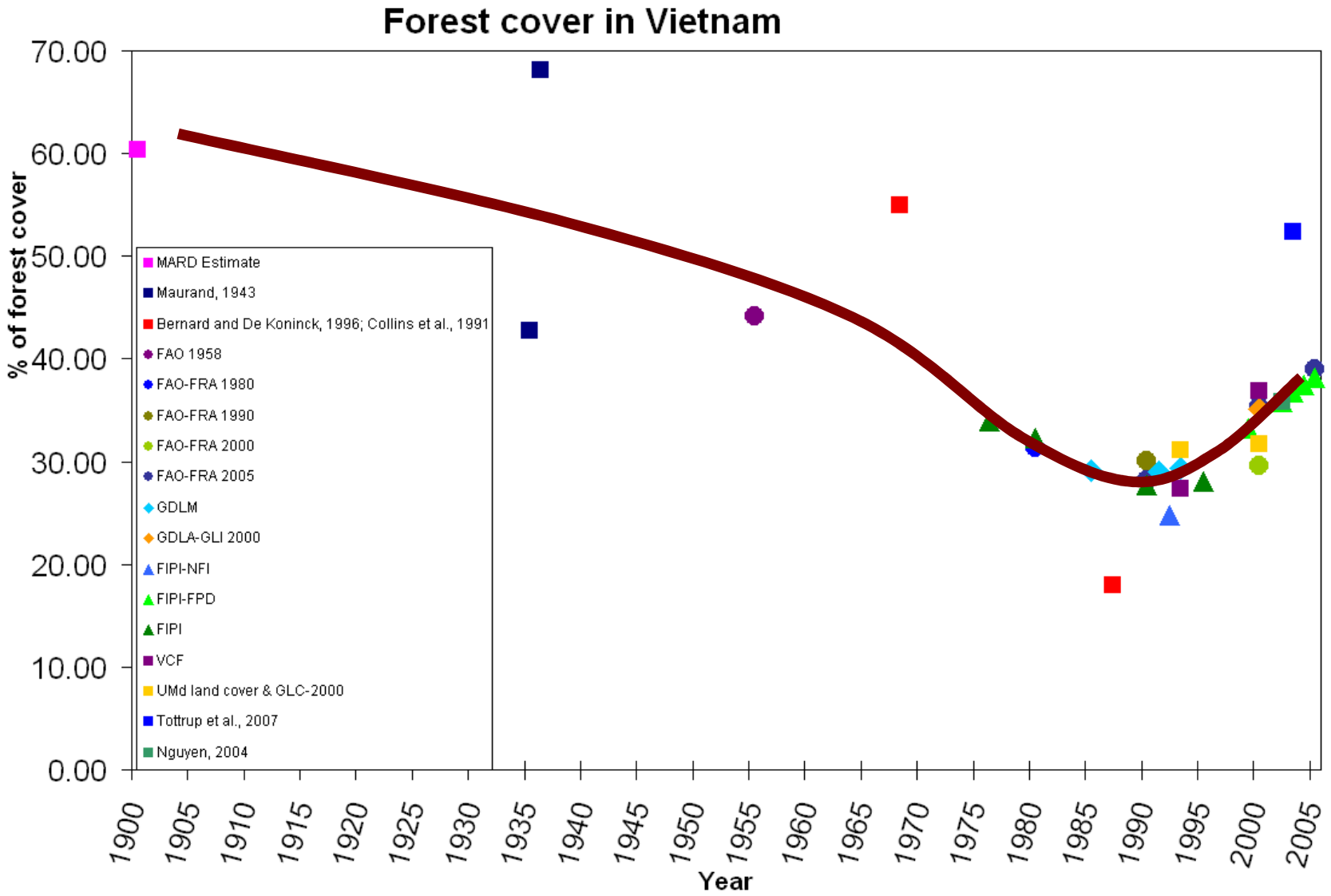
Agroforestry systems, fruit orchards, secondary successions, wood lots, abandoned pastures, gardens, hedgerows

Conservation value; provide multiple ecosystem services

No decline in rural population or agriculture

Smallholders decrease their vulnerability & guarantee their livelihood through ecological and economic diversification

Lambin and Meyfroidt 2010;
Meyfroidt and Lambin 2011



Forest transition in **1991-1993** with **25-31%** of forest cover

Forest cover of **32-37% in 1999-2001**

Reforestation of **2.5 – 3.2 Mha between 1992 and 2000**

Meyfroidt & Lambin, *GCB*, 2008a

Teak plantation (*T. grandis*)
~10 years

~50%: tree plantation
~50%: natural regeneration

Secondary forest
~15 years

Meyfroidt & Lambin, *GCB,* 2008a

Combination of causes

- Policies allocating forestry land to households and regulating land use
- Liberalization of markets for agricultural inputs & outputs
- Land and forest scarcity (population growth & land degradation)

→ **Decline of cultivation on hillsides & forest regeneration**

→ Intensification in lowland plots with high agro-ecological potential

- Increasing timber demand for urban and industrial markets

  Afforestation / reforestation programs

  Local scarcity of forest products

→ **Forest plantations in accessible locations & with capital**

No decline in rural population

Meyfroidt & Lambin, *LUP,* 2008b

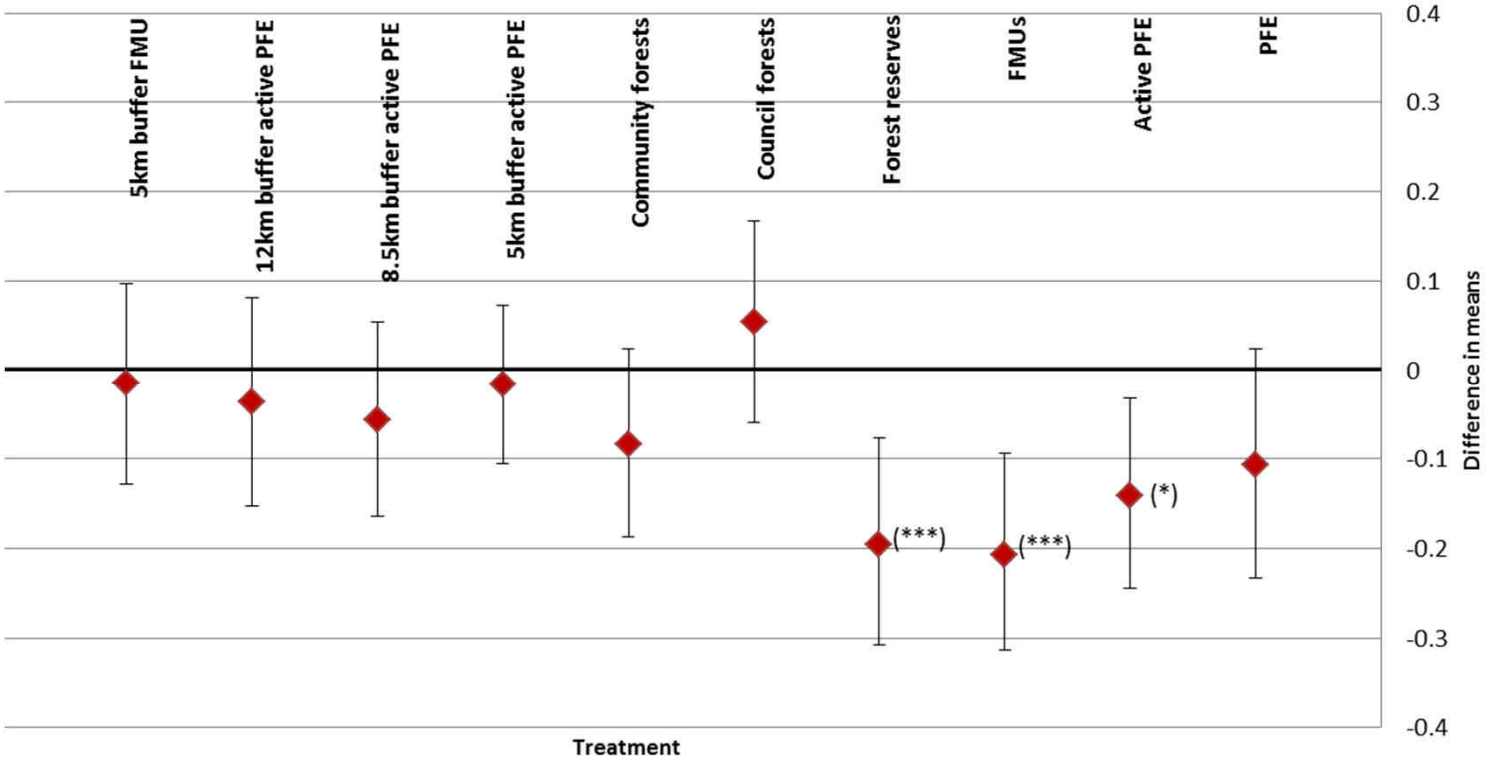
Permanent maize fields in northwestern Vietnam

Improvement of irrigation infrastructure in the paddyfields

Terracing the slopes

Reforestation landscape in northeastern Vietnam

Cameroon



Land zoning, including logging concessions, can be effective to reduce deforestation, and sometimes forest degradation

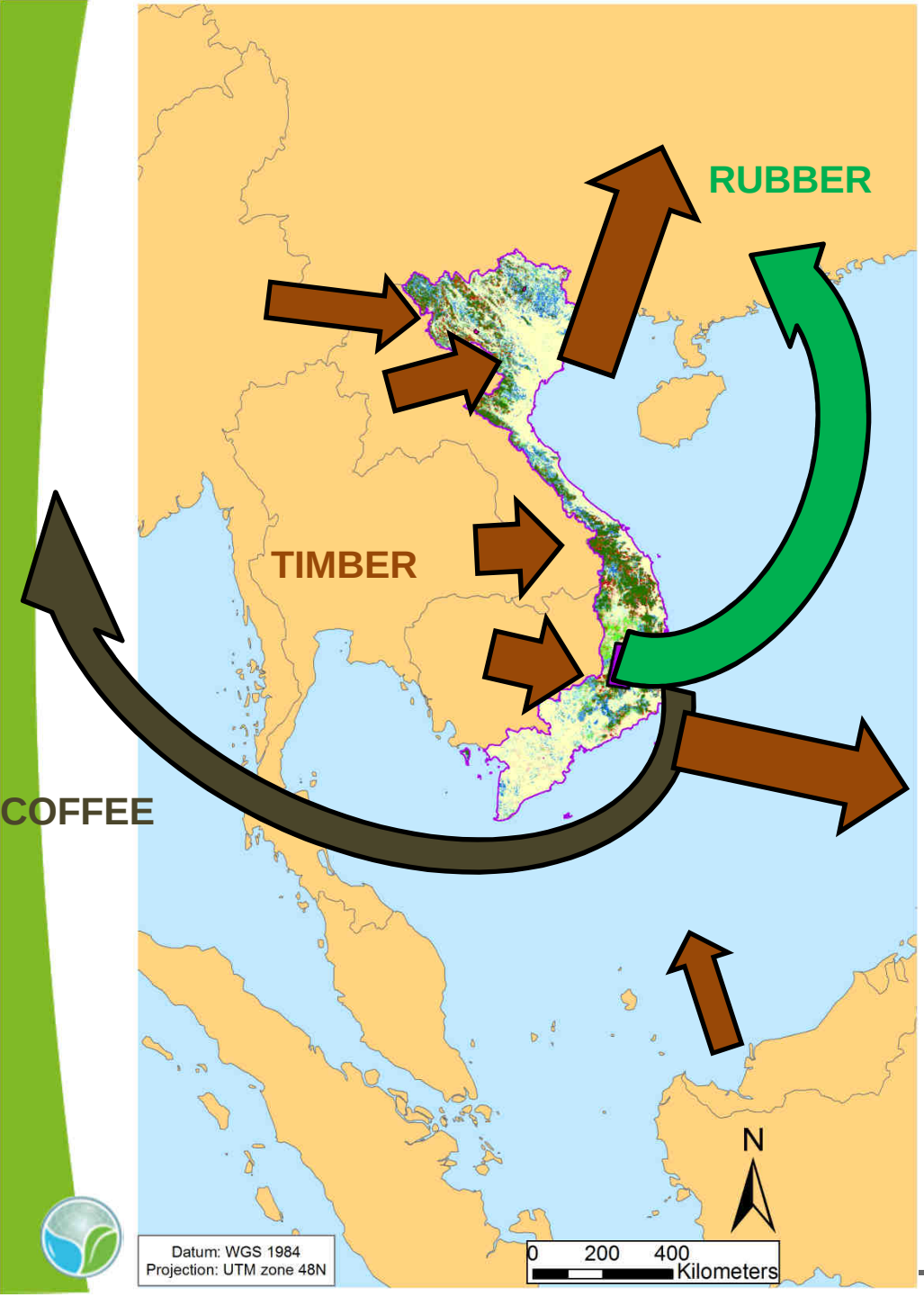
Bruggeman et al. 2014 *Land Use Policy*

Land use policies

- Evidence that LU policies / zoning can be effective;
  - For deforestation, less clear for degradation
  - Spatially explicit, high priority areas (e.g. systematic conservation planning, Margules and Pressey 2000)

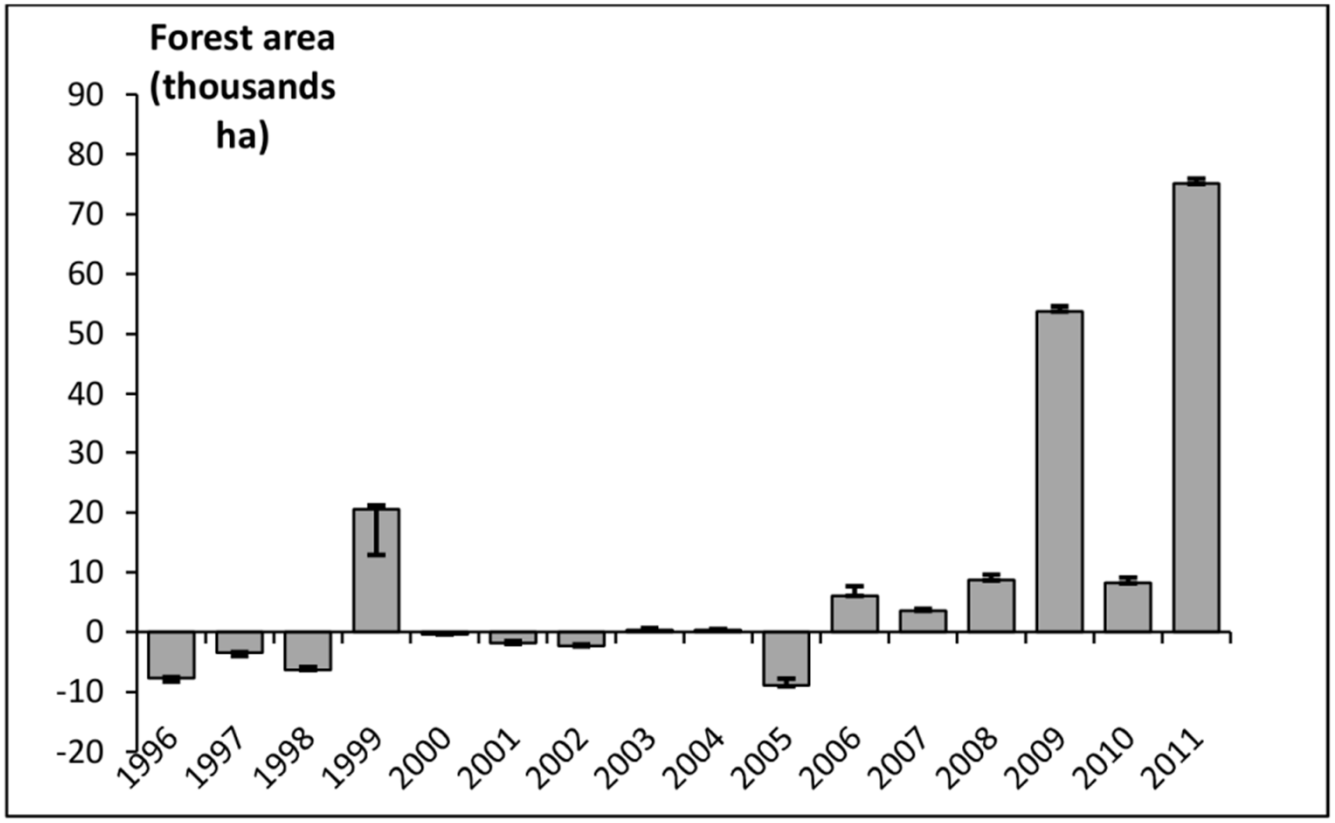
- But:
  - No zero deforestation
  - Displacement / leakage (limited local, but international)
  - Loopholes
  - Environmental effects e.g. soil degradation / erosion
  - Cost-effectiveness / livelihoods; political process
  - Difficulty to manage multifunctional land uses

- Combination of supply & demand approaches; Contextual effects: same policy not same effect everywhere



Meyfroidt and Lambin 2009 *PNAS*
Meyfroidt et al. 2013 *GEC*

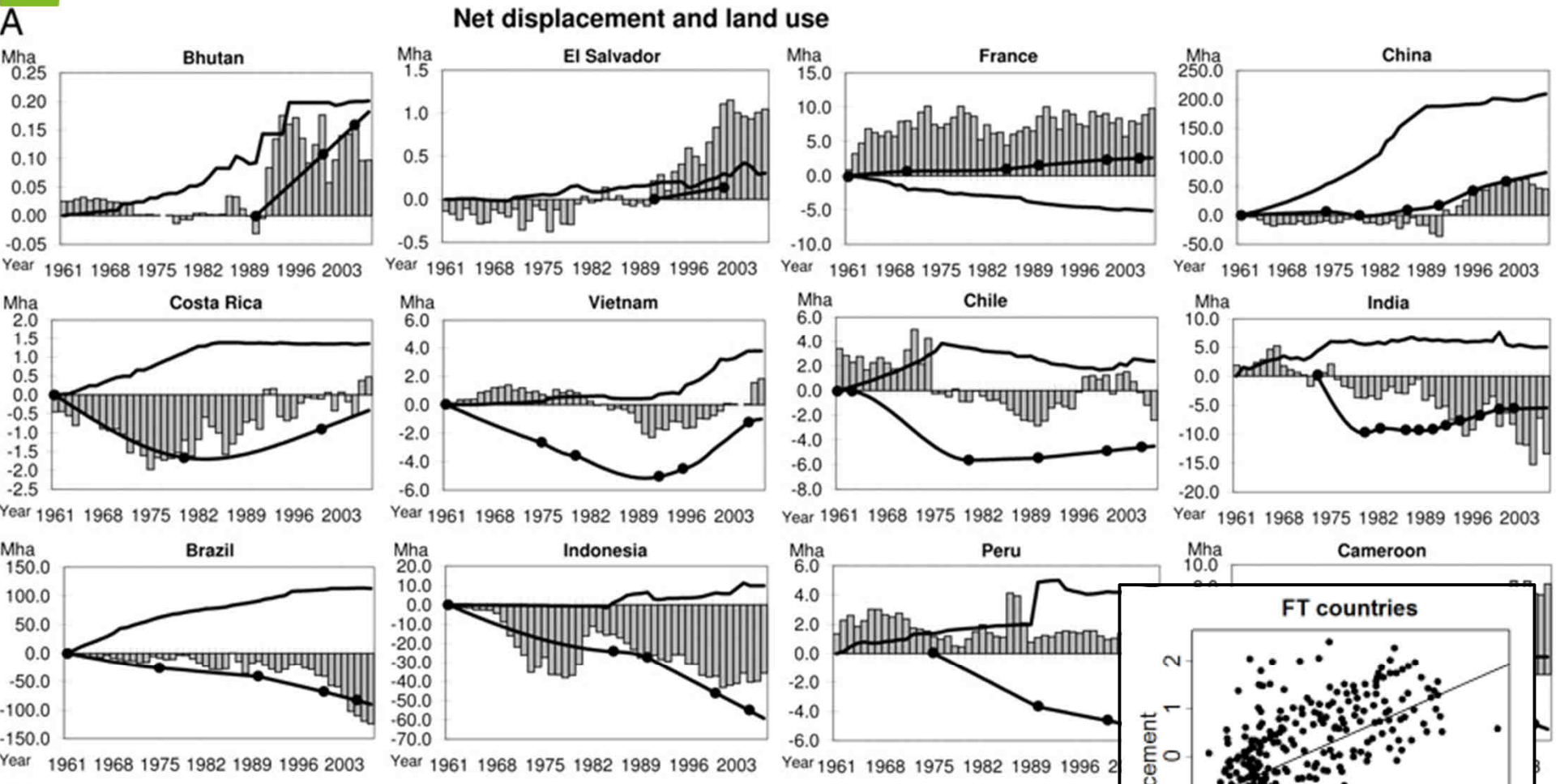
Bhutan

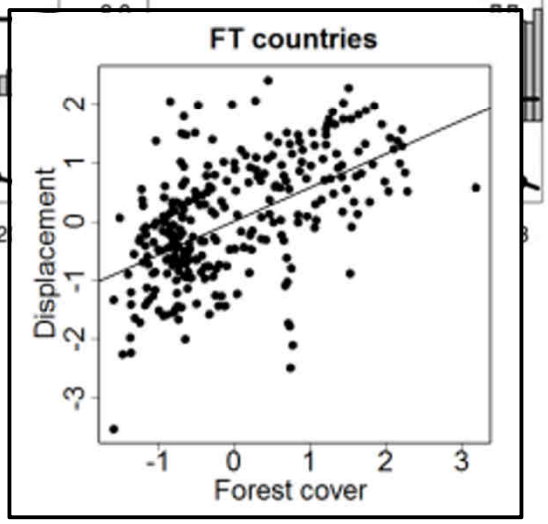


Forest use displacement to India (charcoal) to feed industrial upgrading and exports of higher added-value products (calcium-carbide and ferrosilicon)

Jadinet al. Submitted

Forest transitions & displacement





Meyfroidt et al., 2010, PNAS

Conclusion

Solutions & caveats

- Target expansion on "**potentially available cropland**" → But no real "free" land, always tradeoffs
- **Land use policies**, control expansion → But displacement / leakage
- Demand-side signals towards sustainable land uses, **market-based instruments** → See Eric's talk
- **Sustainable Intensification** → But rebound-effect, + multiple dimensions
- **Food security:** distribution, income → Rebound-effect too
- **Reduce demand** for most resource-demanding products (diets, wastes)
- **Agroecology**: land use which addresses food security issues → But urban demand for multiple land-based resources - food, wood, energy...; at least 2 billion more urban people in 2050.