Georg-August-Universität Göttingen
January 29, 2014

Forests and Climate Change in the Tropics: Challenges in their role in climate change mitigation and adaptation

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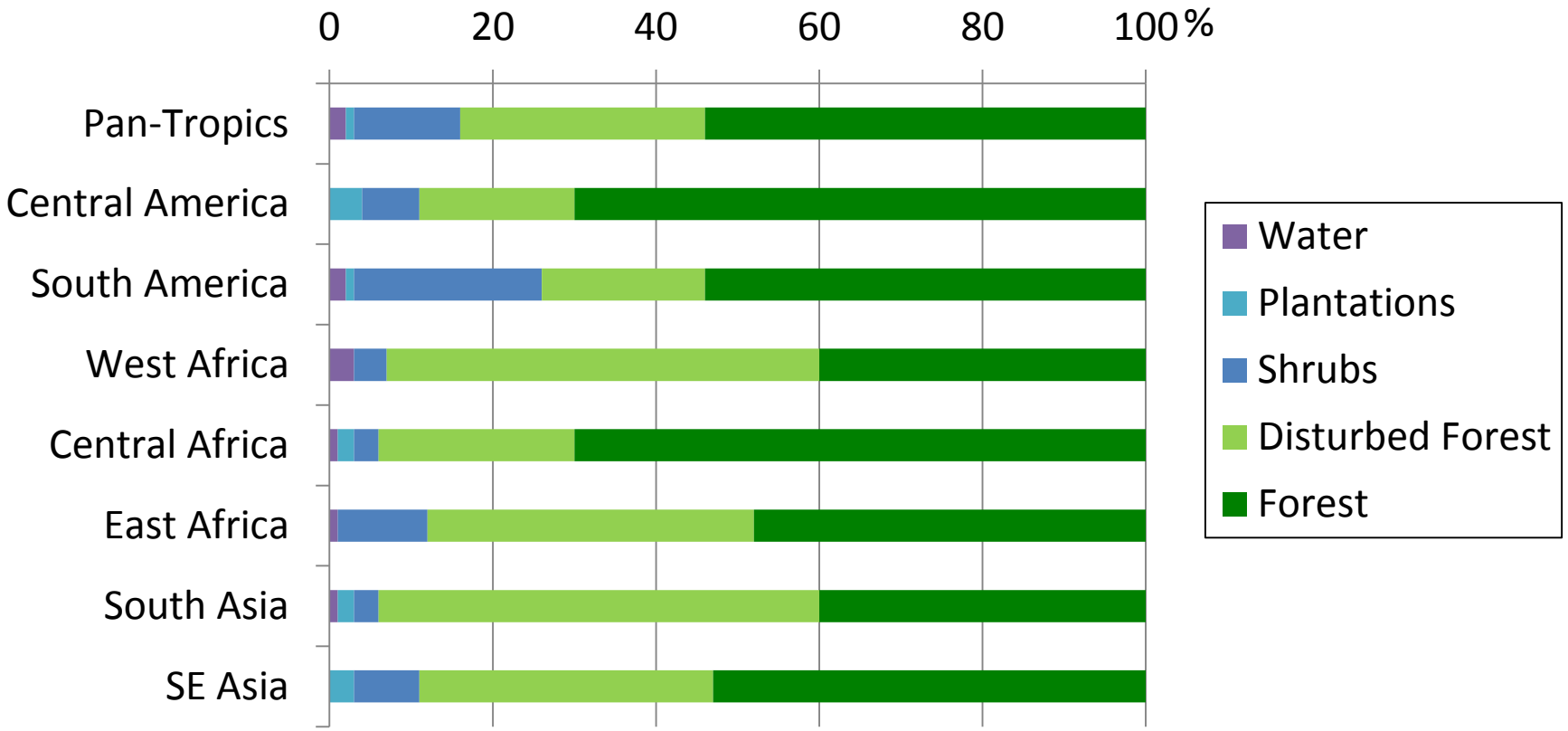
Contents

- Land-use changes
  - Trends in recent years
  - Foreign investments in agriculture
- Role of forests
  - Ecosystem-based adaptation
  - Deforestation and forest degradation
  - Climate change mitigation - REDD+

Trends in forests and land use

- During the last 40 years
  - Population 4 -> 7 billion
  - Deforestation: 500 million Ha
  - Consumption of forest products: 50% increase
- During the next 40 years
  - Population 7 -> 9 billion
  - Deforestation: 400 million Ha
    - Over 100 million hectares of new agricultural land
    - Biofuel expansion, mining, urbanization etc.
  - Consumption of forest products: 50% increase
    - 40-50% of industrial wood from plantations
  - Importance of forest ecosystem services increases
    - Carbon, water, etc.
  - Climate change – adaptation and mitigation

The origins of new agricultural land, 1980–2000

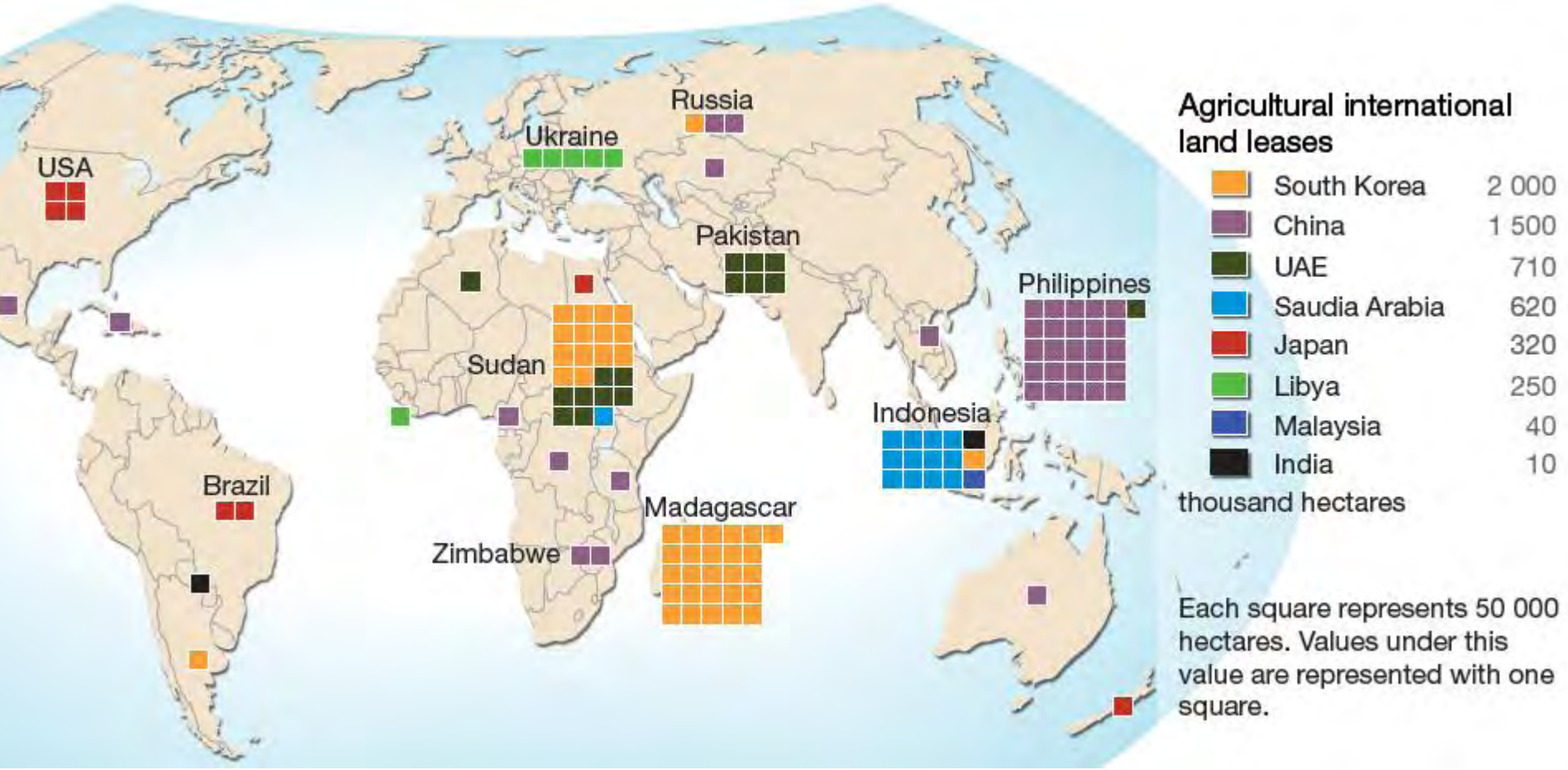


Gibbs et al. 2010

Investor and target regions and countries in overseas land investment for agriculture, 2006-2009

Source: UNCTAD 2009

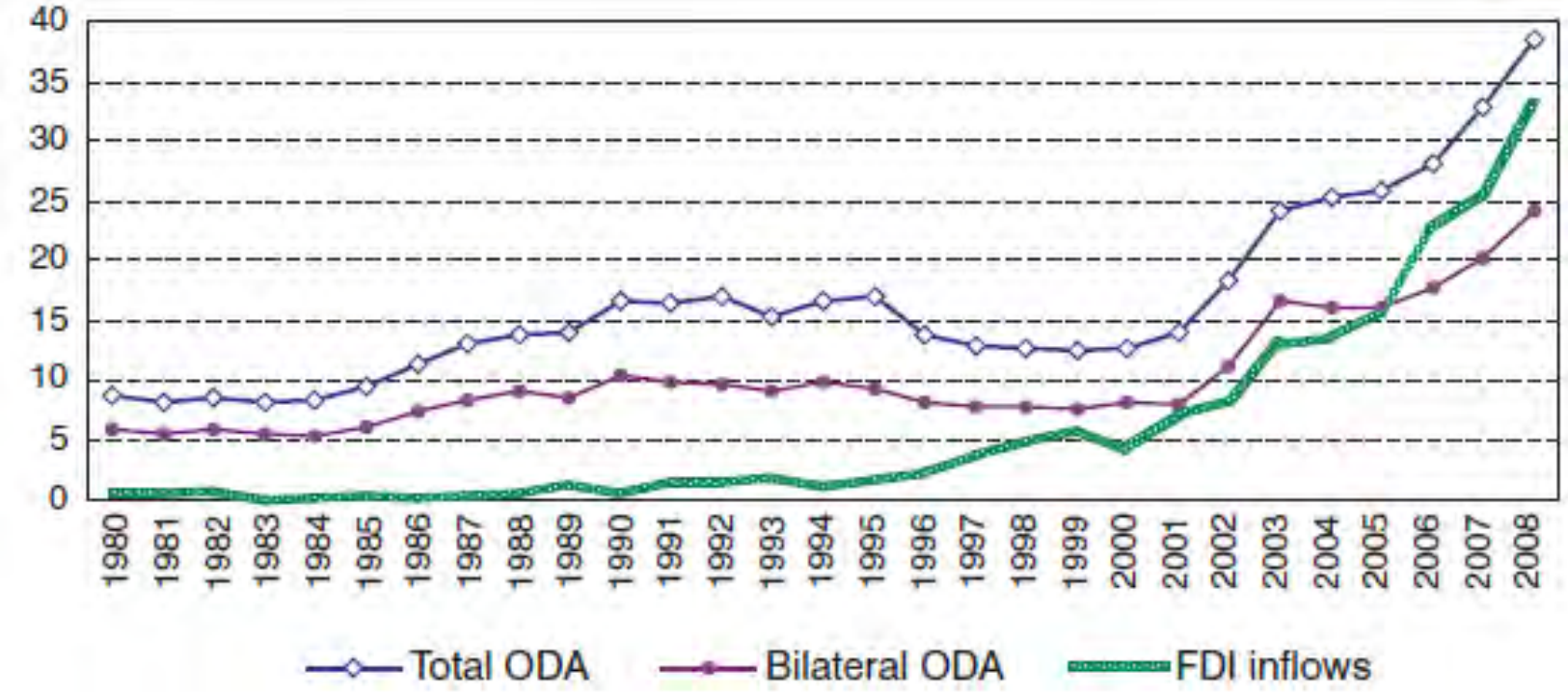
Leasing land for agricultural production



Source: UNCTAD 2009

Foreign direct investment and ODA flows to LDCs, 1980–2008

(Billion USD)

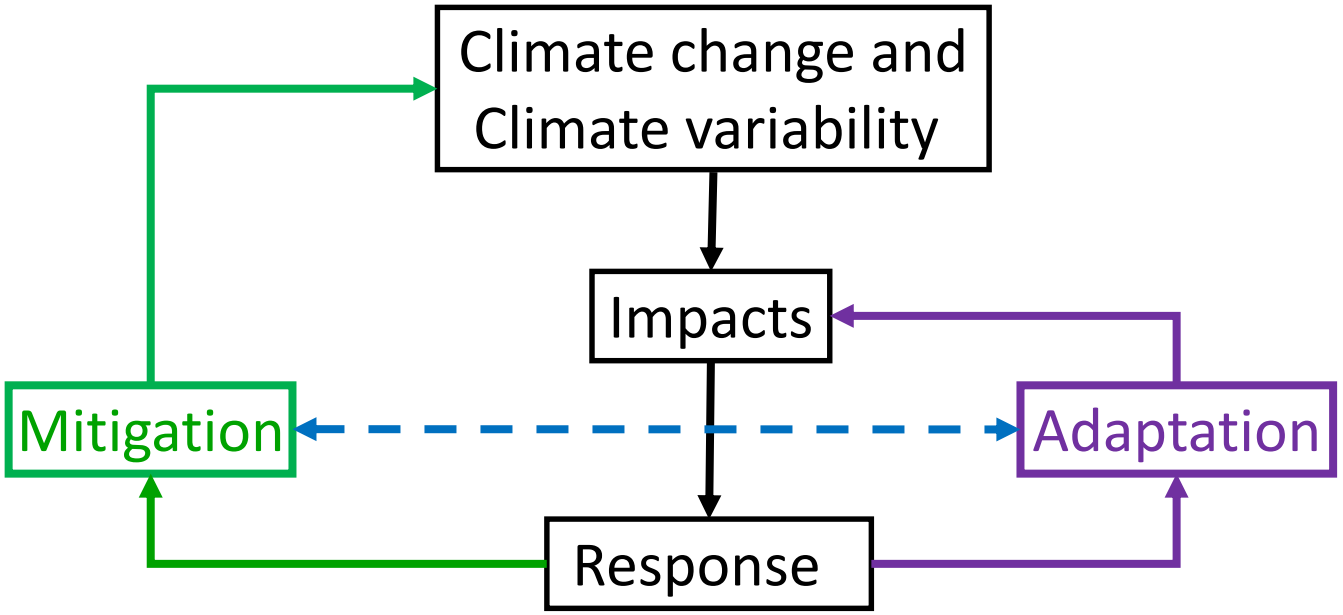


Source: UNCTAD 2010

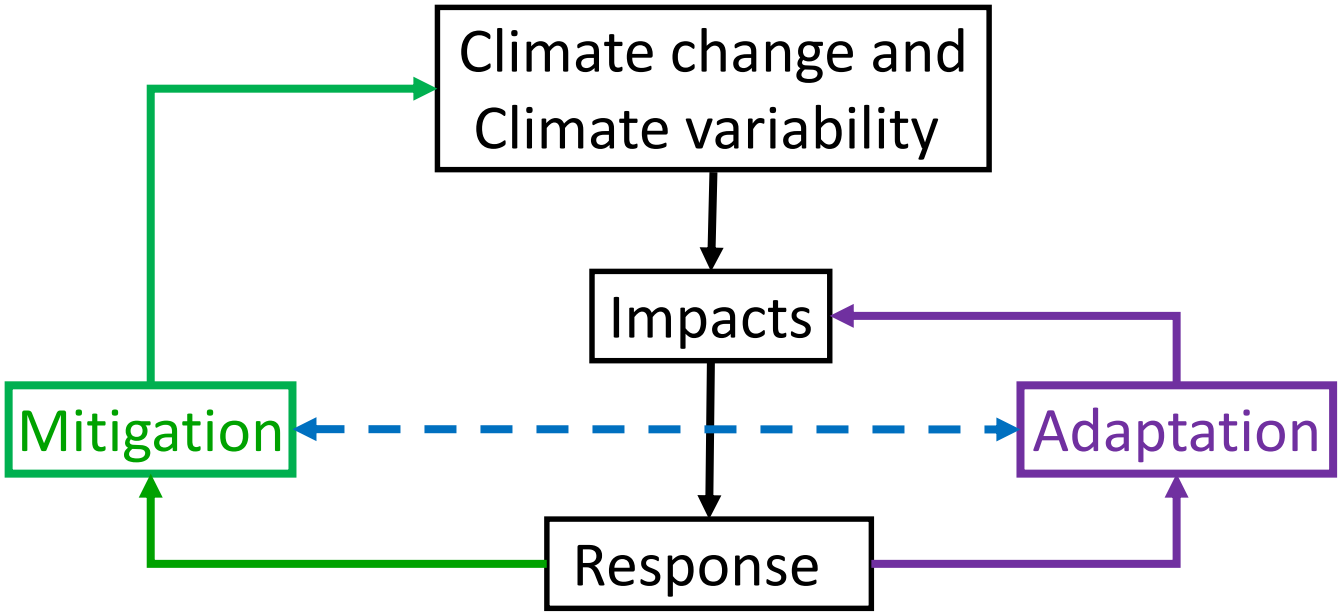
Emerging picture

- The consumption of raw materials, water, food, and bioenergy increases rapidly in emerging economies (BRICS and other countries)
- Global demand for agricultural products such as food, feed, and fuel is now a major driver of cropland and pasture expansion across much of the developing world
- Tropical forests are converted to agriculture, cattle raising, energy production, and to mining
- Foreign direct investments in agriculture and land use increase particularly in Africa and Asia
  - China and other emerging economies become major investors in land use

Forests and climate change: Mitigation and adaptation



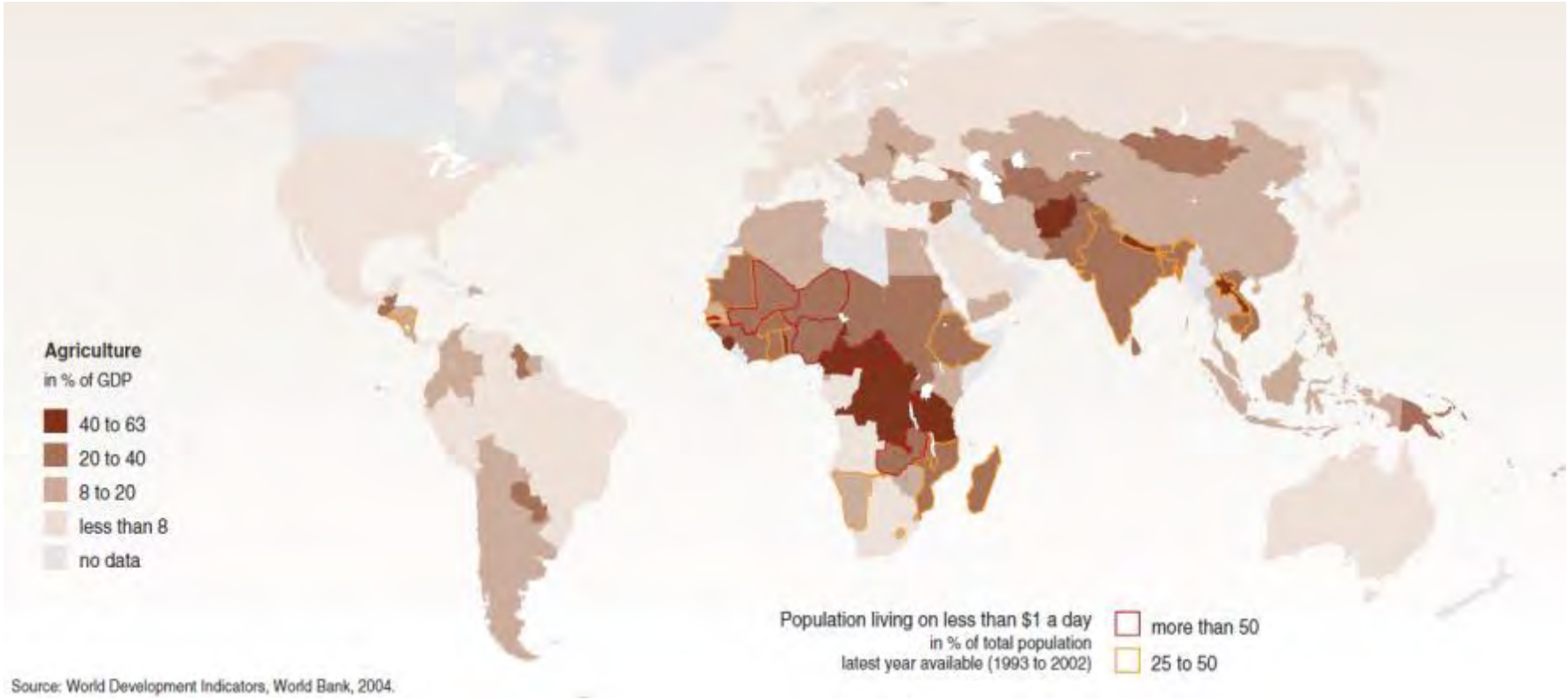
Forests and climate change: Mitigation and adaptation



… maintaining and increasing ecosystem C pools and C sequestration – reducing emissions from biosphere

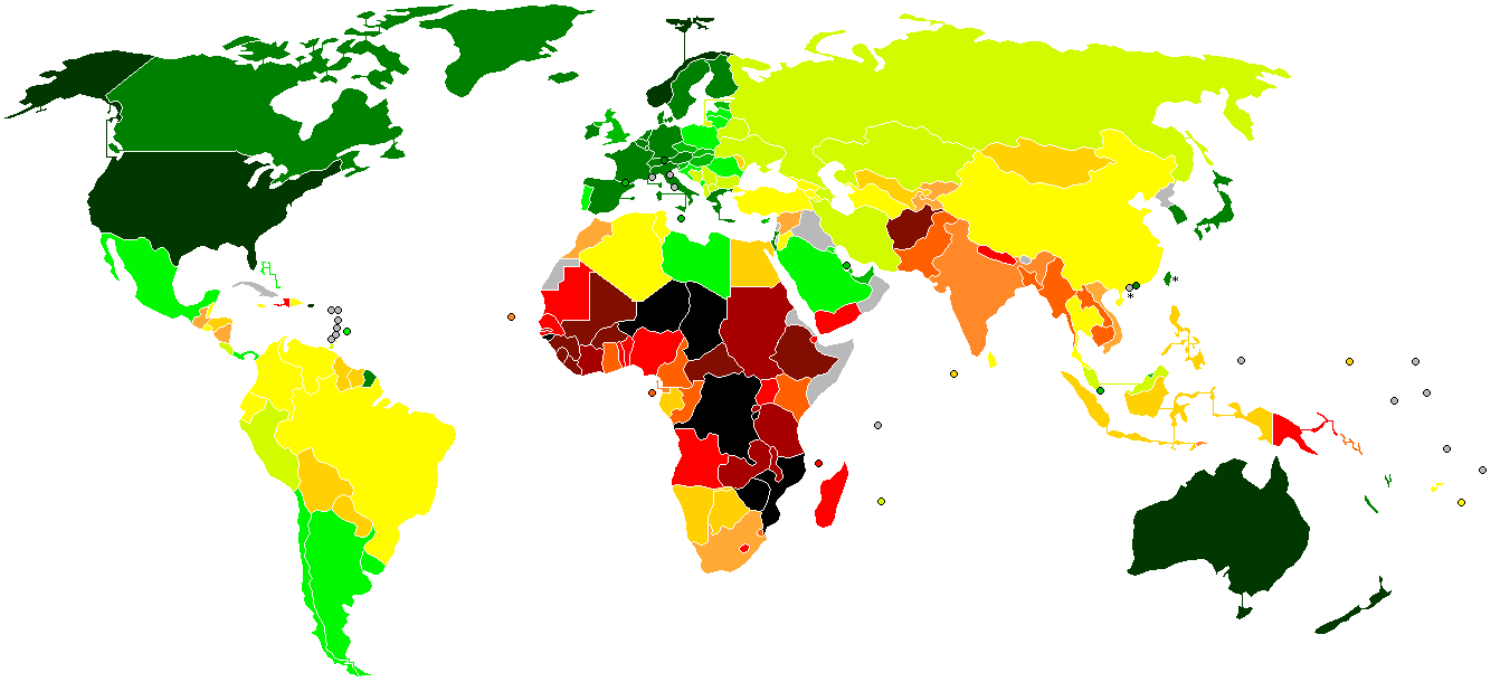
… maintaining and increasing ecosystem resilience – reducing vulnerability

Agriculture in % of GDP



http://maps.grida.no/go/graphic/economies-at-risk-disasters-poverty-and-agricultural-dependence

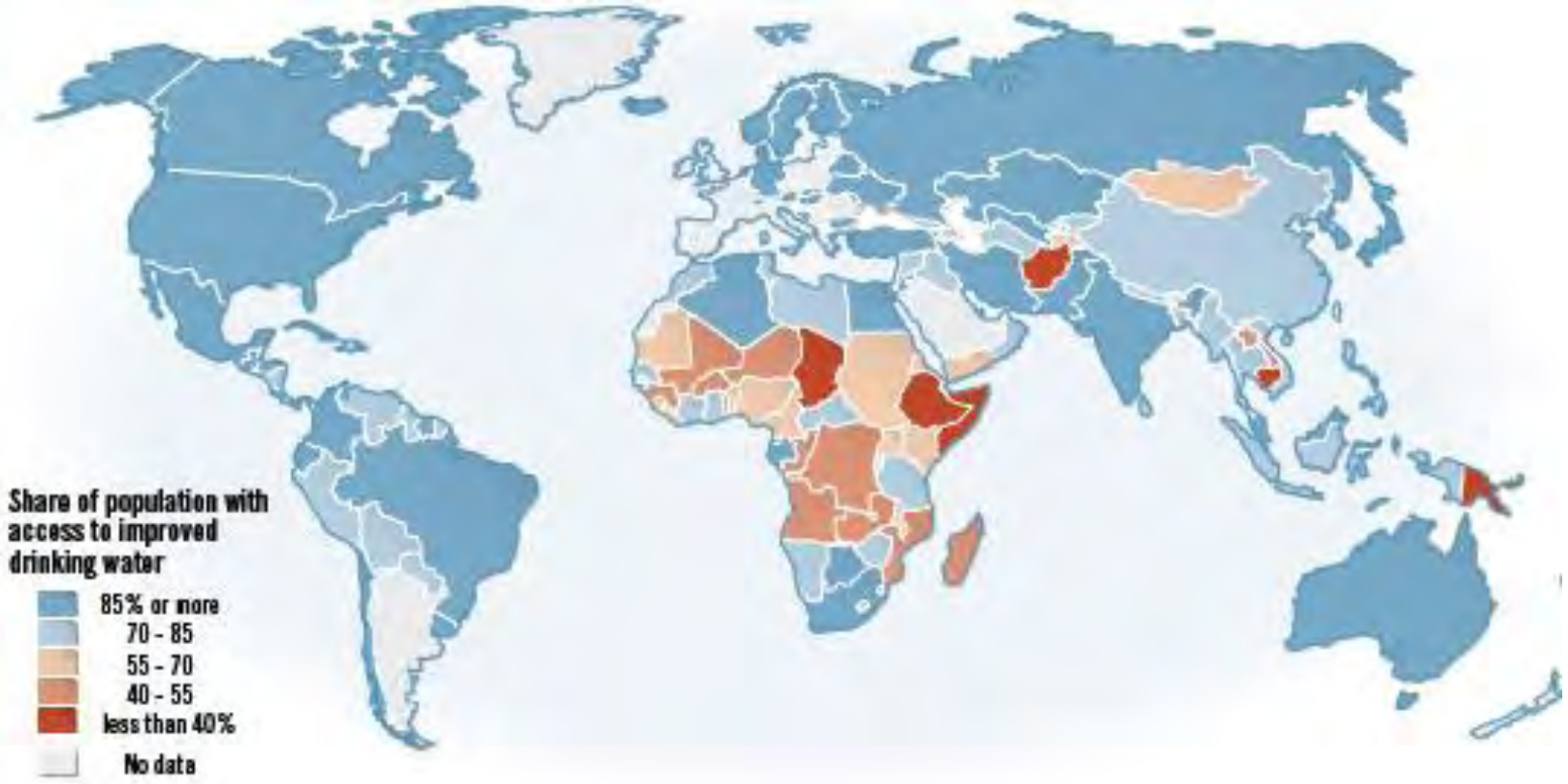
Human Development Index



World map indicating the Human Development Index (based on 2010 data, published on November 4, 2010)[1]

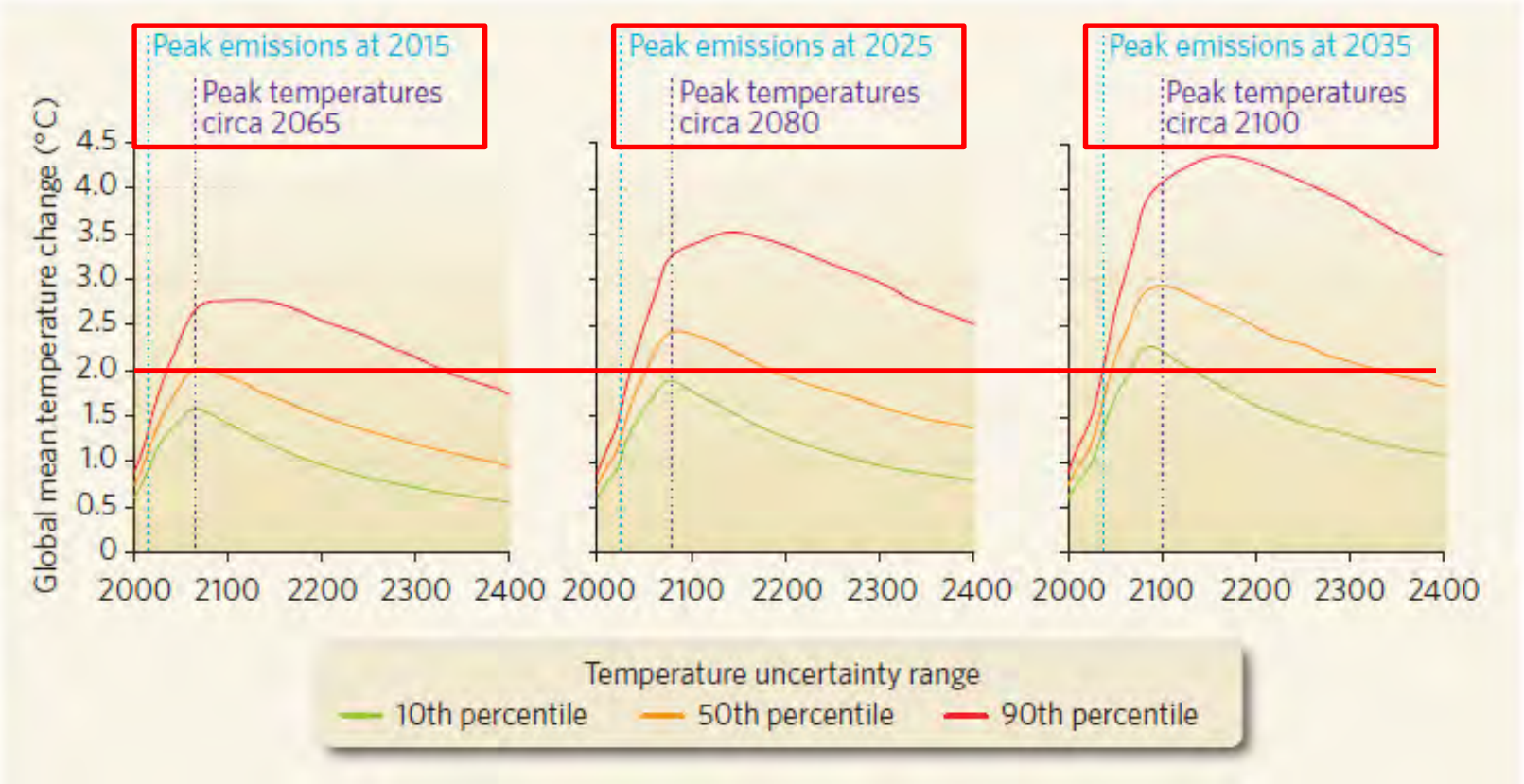
0.900 and over	0.650–0.699	0.400–0.449
0.850–0.899	0.600–0.649	0.350–0.399
0.800–0.849	0.550–0.599	0.300–0.349
0.750–0.799	0.500–0.549	under 0.300
0.700–0.749	0.450–0.499	Data unavailable

Share of population with access to improved drinking water



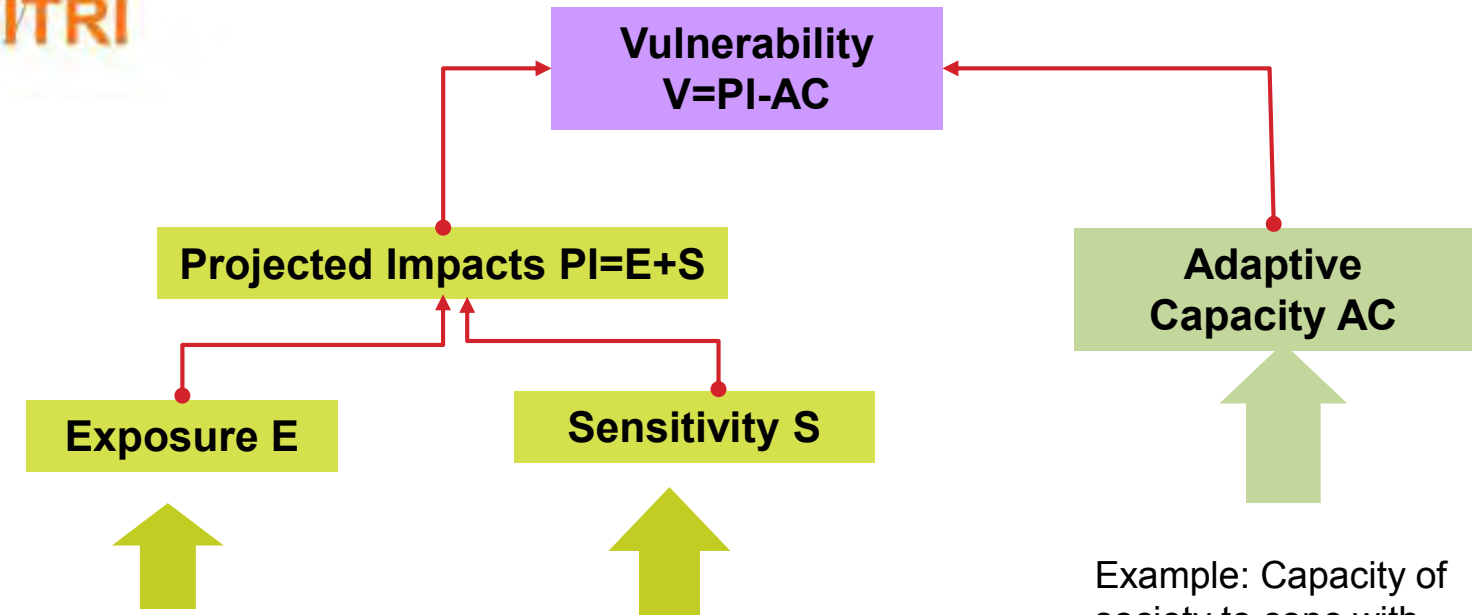
Urgency of action (overshoot, adapt, and recover)

Protection of forests allows immediate climate action



Parry et al. 2009

Components of vulnerability



Example: Exposure of production systems and human settlements to flooding

Example: Sensitivity of agricultural systems to drought

Example: Capacity of society to cope with flooding

Example: Capacity of ecosystems to cope with climate change

Adaptation: Decrease E

Adaptation: Decrease S

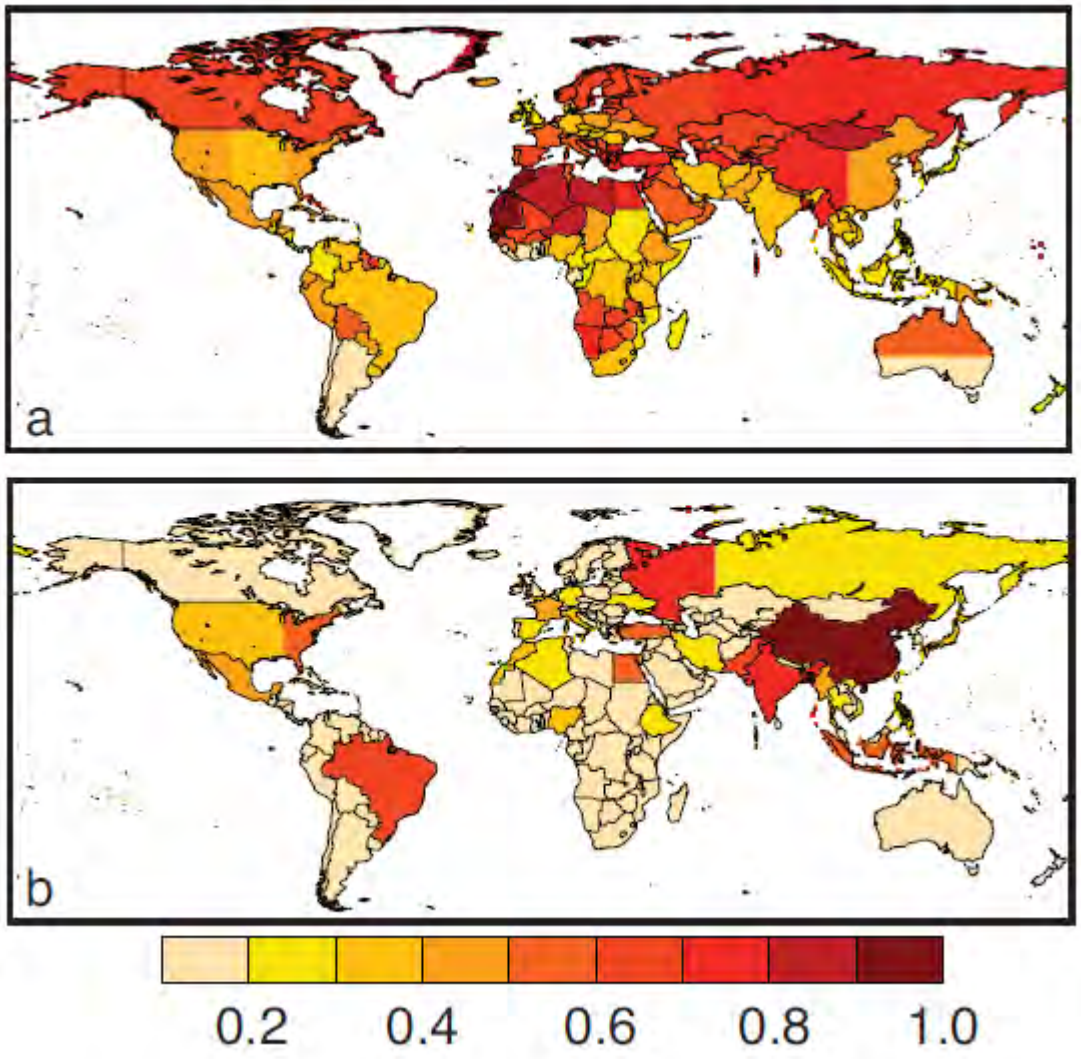
Adaptation: Increase AC

IPCC 2001

Exposure of population to climate change

a) National climate change index (NCCI)
(weighted changes in T, precipitation, sea level)

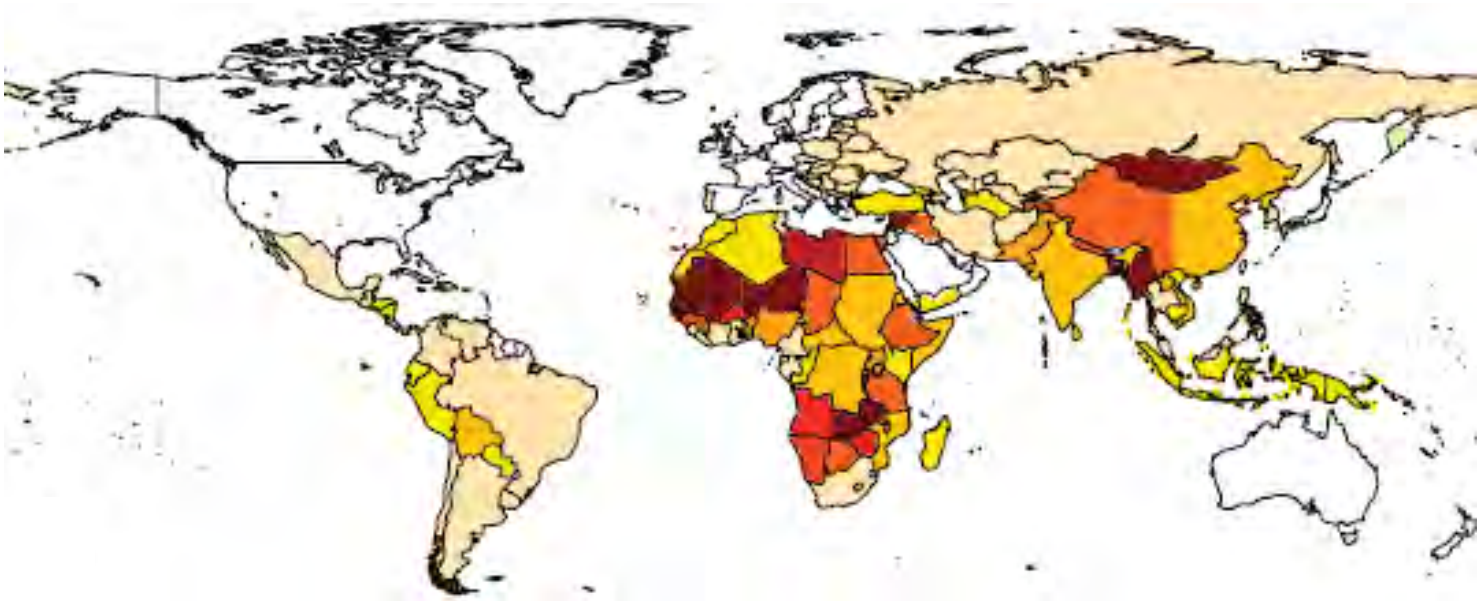
b) Climate change population index
(NCCI x the total population of each nation)



Diffenbaugh et al. 2007

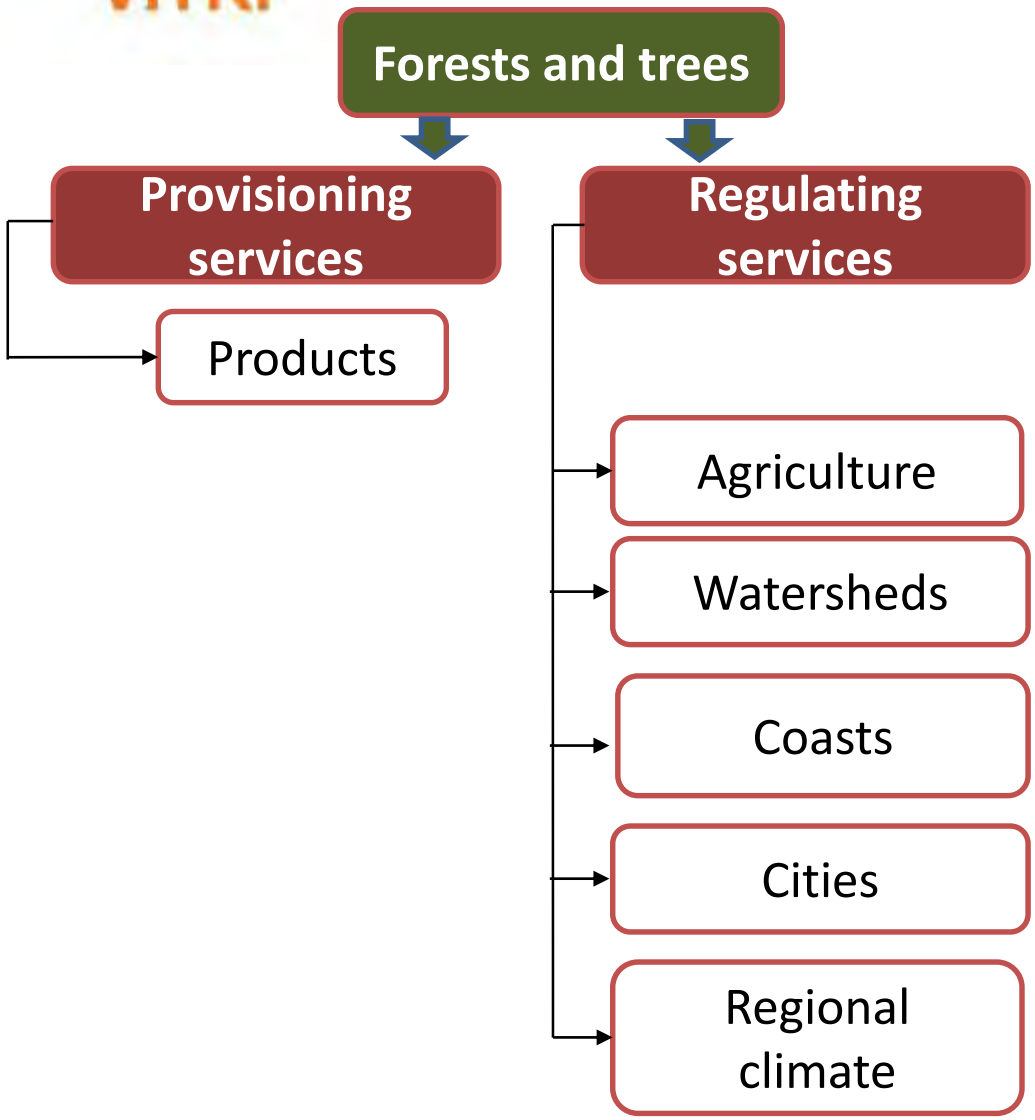
Climate change poverty index

= National climate change index (NCCI) x population living on less than 2 USD per day

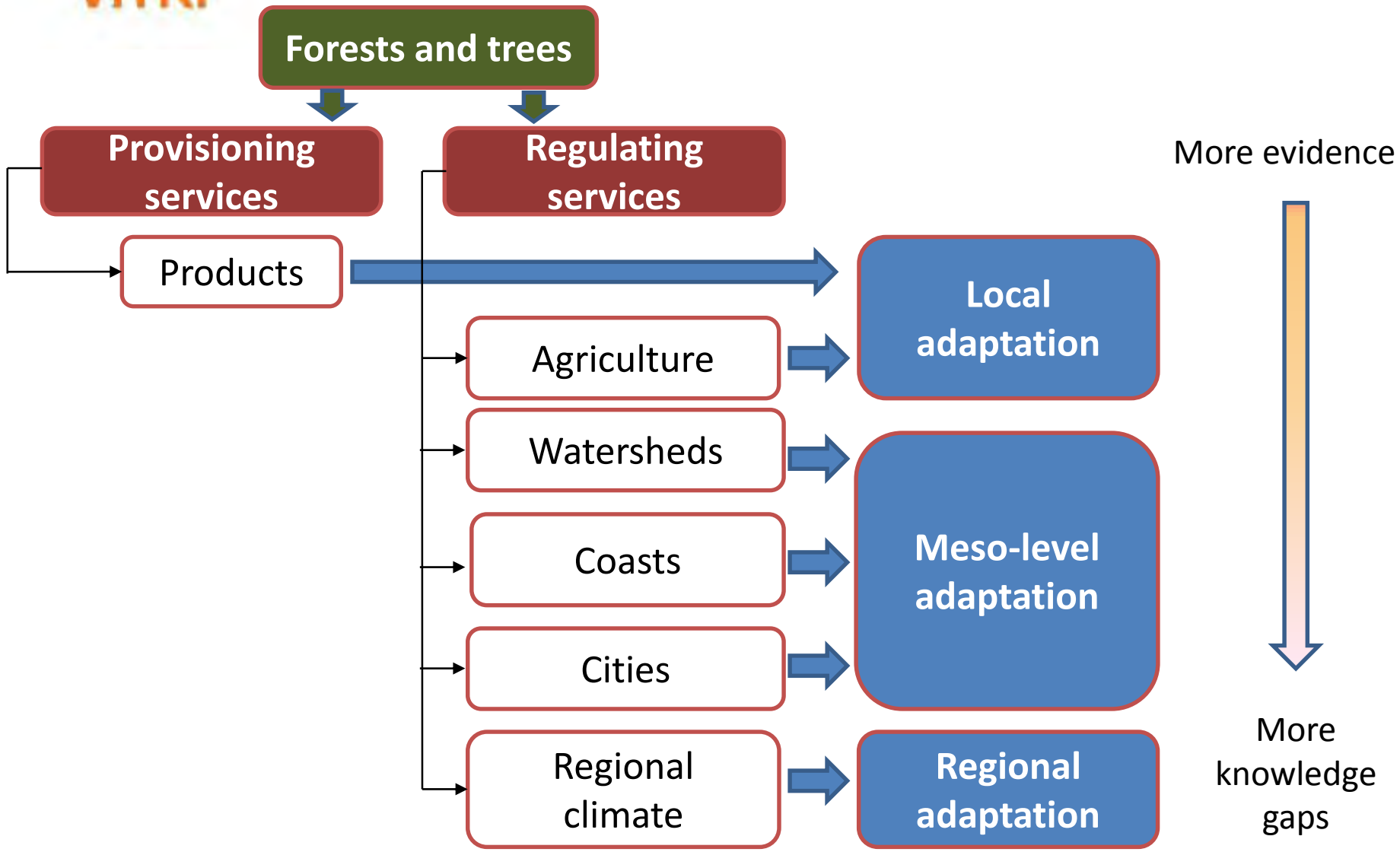


Diffenbaugh et al. 2007

Forest ecosystem services and adaptation



Forest ecosystem services and adaptation



Ecosystem-Based Adaptation

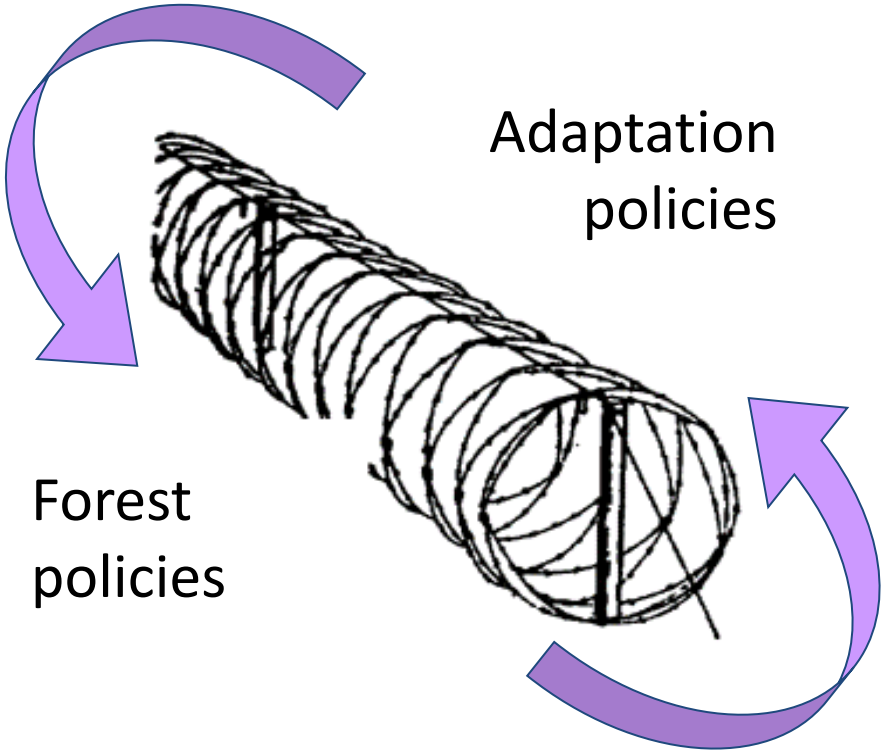
- Adaptation measures or policies that harness ecosystem services for adapting society to climate change
- Is necessarily:
  - Multi-sectoral (e.g. water & agriculture & forest communities)
  - Multi scale (local, meso/watershed, national, regional)

Ecosystem-Based Adaptation

- Considers:
  - The vulnerability of ecosystems and livelihoods (to land-use change, over-harvesting, climate change, etc.).
  - The links between ecosystem services and societal vulnerability
- Approaches:
  - Communities and other stakeholders and decision makers in managing or protecting forest ecosystem services
    - Community risk assessment
    - Participatory vulnerability mapping
    - Adaptation planning

Policies for Ecosystem-Based Adaptation

Mainstreaming adaptation into forest policies



Bringing adaptation into the forest arena:

- Adaptation in NTF's

Bringing forests into the adaptation arena:

- Forests in NAPA's
- Adaptation Fund etc. financing schemes

Estimations of annual adaptation costs in developing countries in 2015

Source	USD billion	Comments
World Bank (2006)	9-41	Cost of climate-proofing FDI, GDI and ODA flows
Stern (2006)	4-37	Update, with slight modification of World Bank (2006)
Oxfam (2007)	>50	Based on World Bank, plus extrapolation of costs from NAPAs and NGO projects
UNDP (2007)	86-109	World Bank, plus costing of PRS targets, better disaster response
UNFCCC (2007)	27-66	High infrastructure cost
UNFCCC (2007)	11-13	Agriculture, forestry, and fisheries

(Parry et al., 2009)

Multilateral funds for adaptation

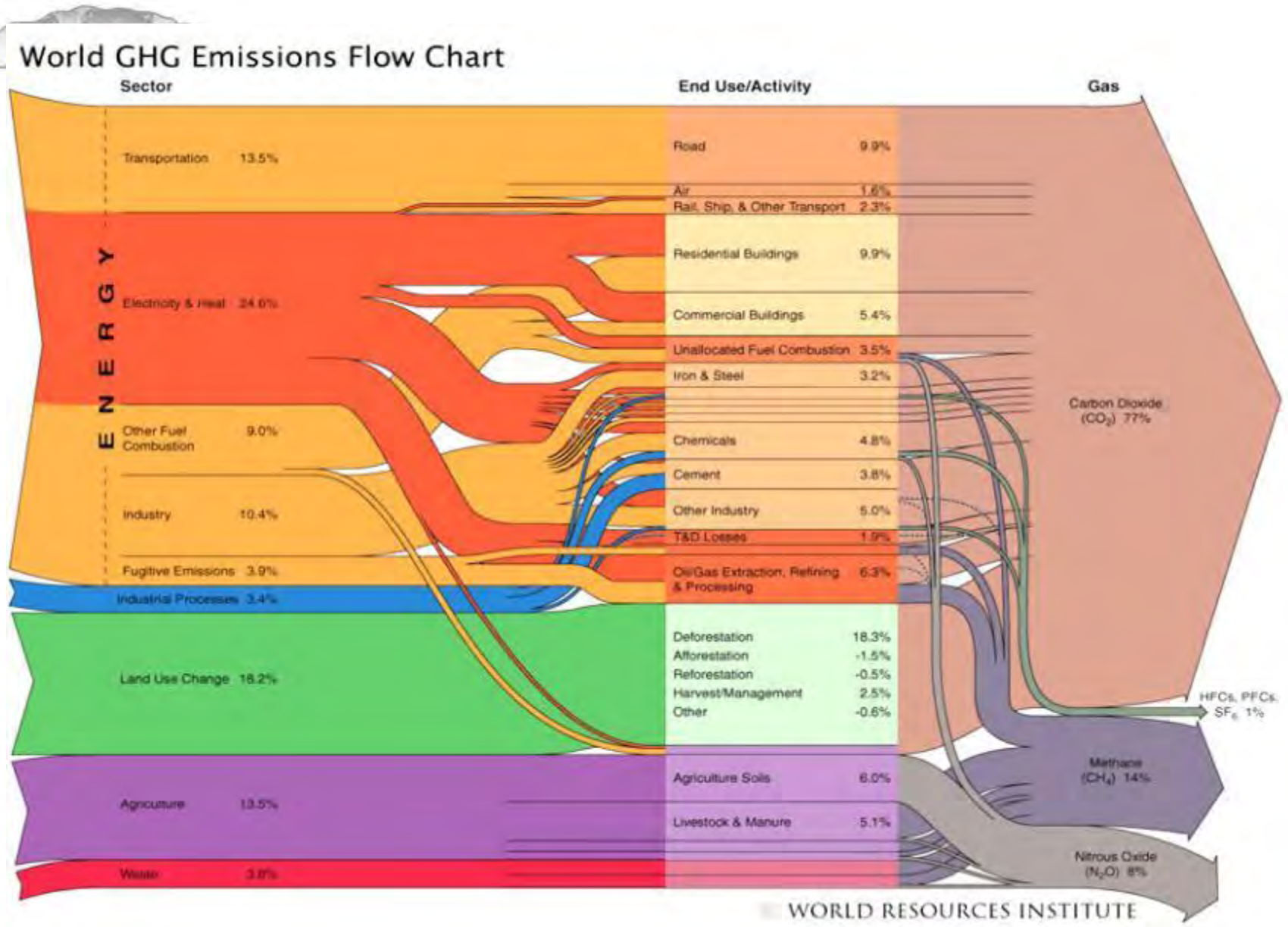
(Modified and updated based on Mohan & Morton, 2009)

Mechanism	Available (M USD)	Comments
Strategic Priority on Adaptation	50	• GEF - UNFCCC • Multilateral financial mechanism funded by developed country pledges
Least Developed Countries Fund (LDCF)	115	• GEF - UNFCCC • Supports the preparation and implementation of National Adaptation Plans of Action (NAPAs)
Special Climate Change Fund (SCCF)	65	• GEF - UNFCCC • Supports long term mitigation and adaptation needs of developing countries
Pilot Program for Climate Resilience (PPCR)	350	• Part of Strategic Climate Fund within the Climate Investment Funds (CIFs) – World Bank • First imbursements in 2010
Adaptation Fund	350	• UNFCCC/Kyoto – 2% levy on CDM • First project approved in 2010

Forest loss and climate emissions

- Some 12-15% of global carbon emissions are from forest loss and land-use change – mainly in the tropics
- More carbon to the atmosphere than comes from the fossil fuel-intensive global transport sector
- In many developing countries, emissions from land-use change account for 60-90% of total national emissions

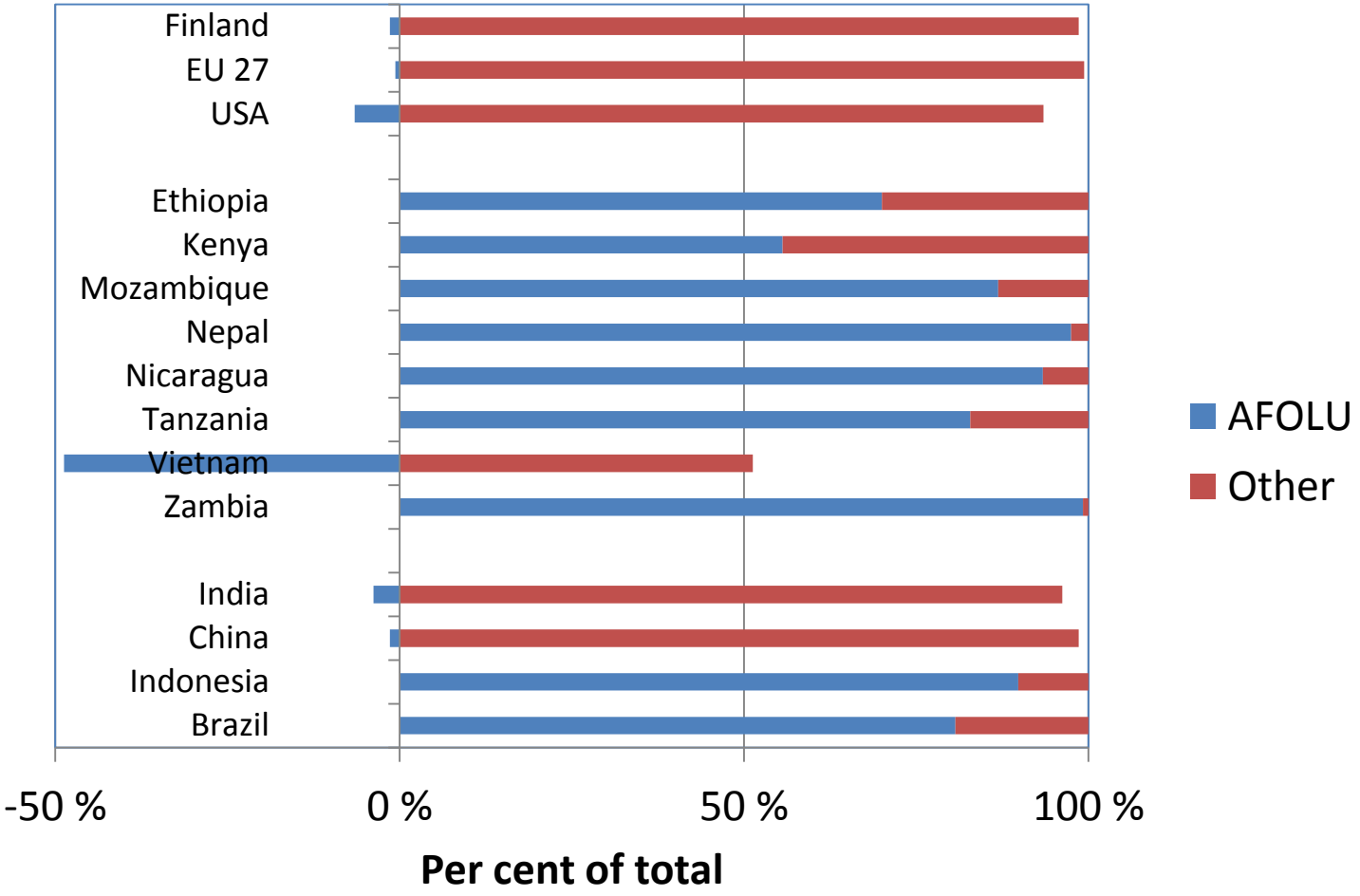




Source: WRI, 2005. Navigating the Numbers: Greenhouse Gas Data and International Climate Policies

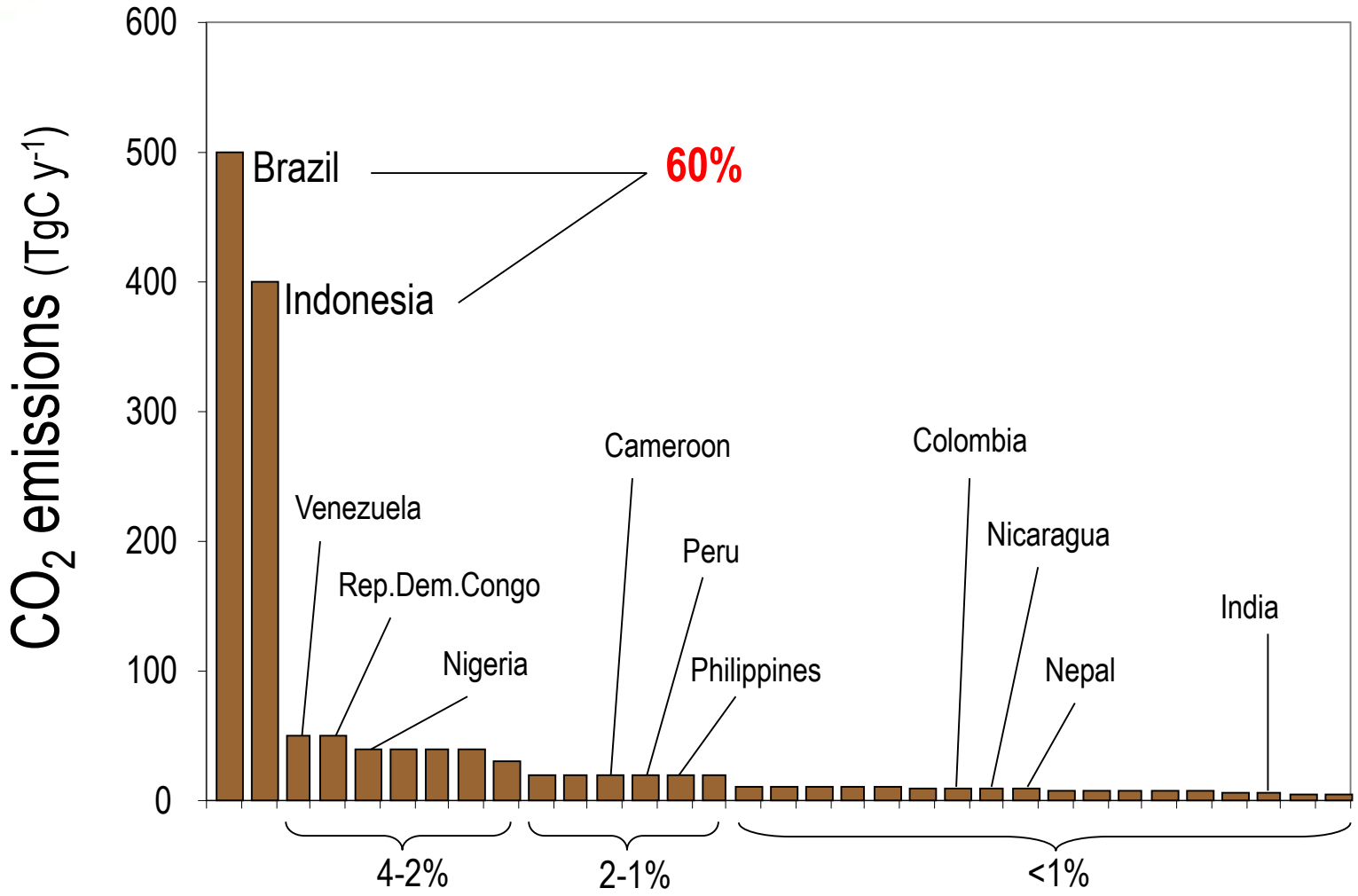
Total CO_2 emissions from AFOLU and other sectors (2000)

AFOLU = agriculture, forestry and land-use



Data: WRI

Net CO_2 emissions from land use change in tropical countries



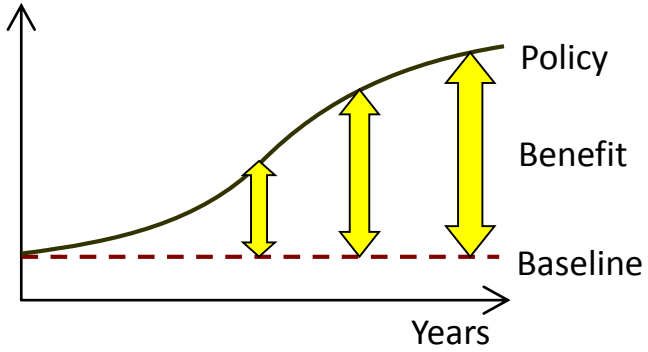
http://www.globalcarbonproject.org/carbonbudget/09/presentation.htm

How can forests mitigate climate change?

Increasing carbon stocks

Creating plantations

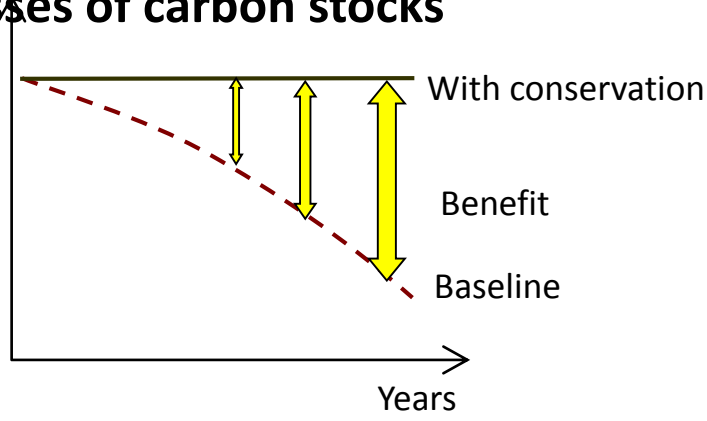
Developing agroforestry



Avoiding losses of carbon stocks

Reducing deforestation and degradation

Applying other REDD+ activities



Producing biomaterials and bioenergy

Forest

Energy

Deforestation and degradation

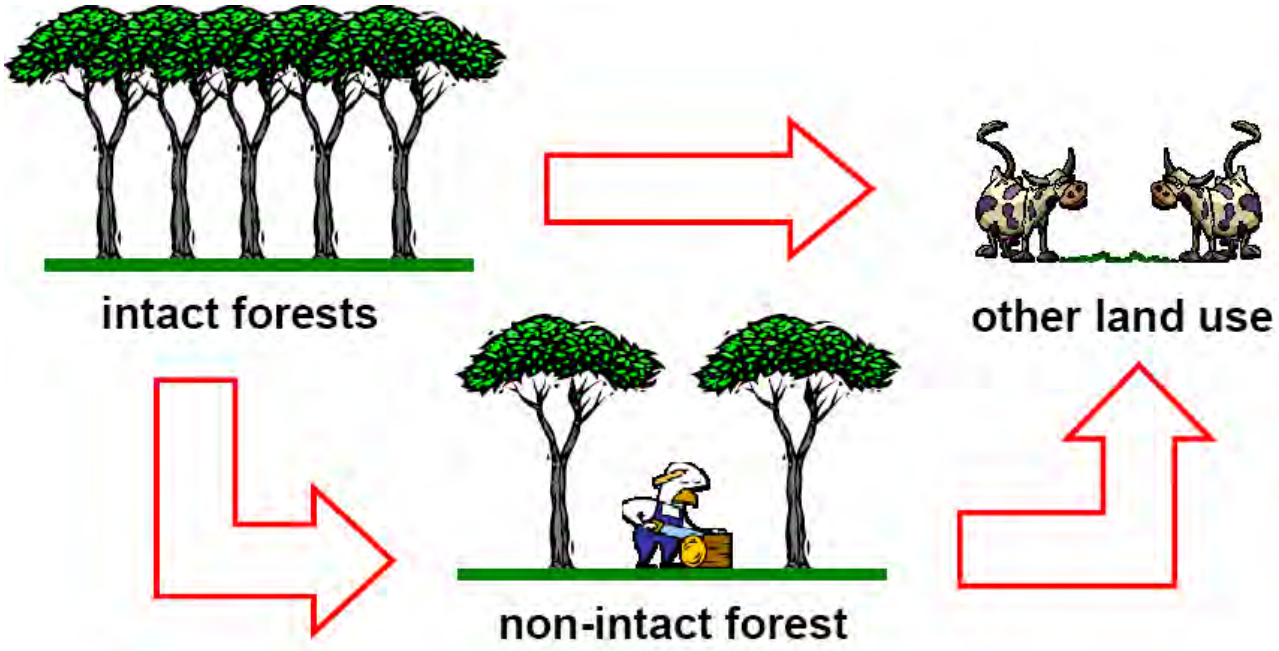
Land use change? → Yes → Deforestation

↓

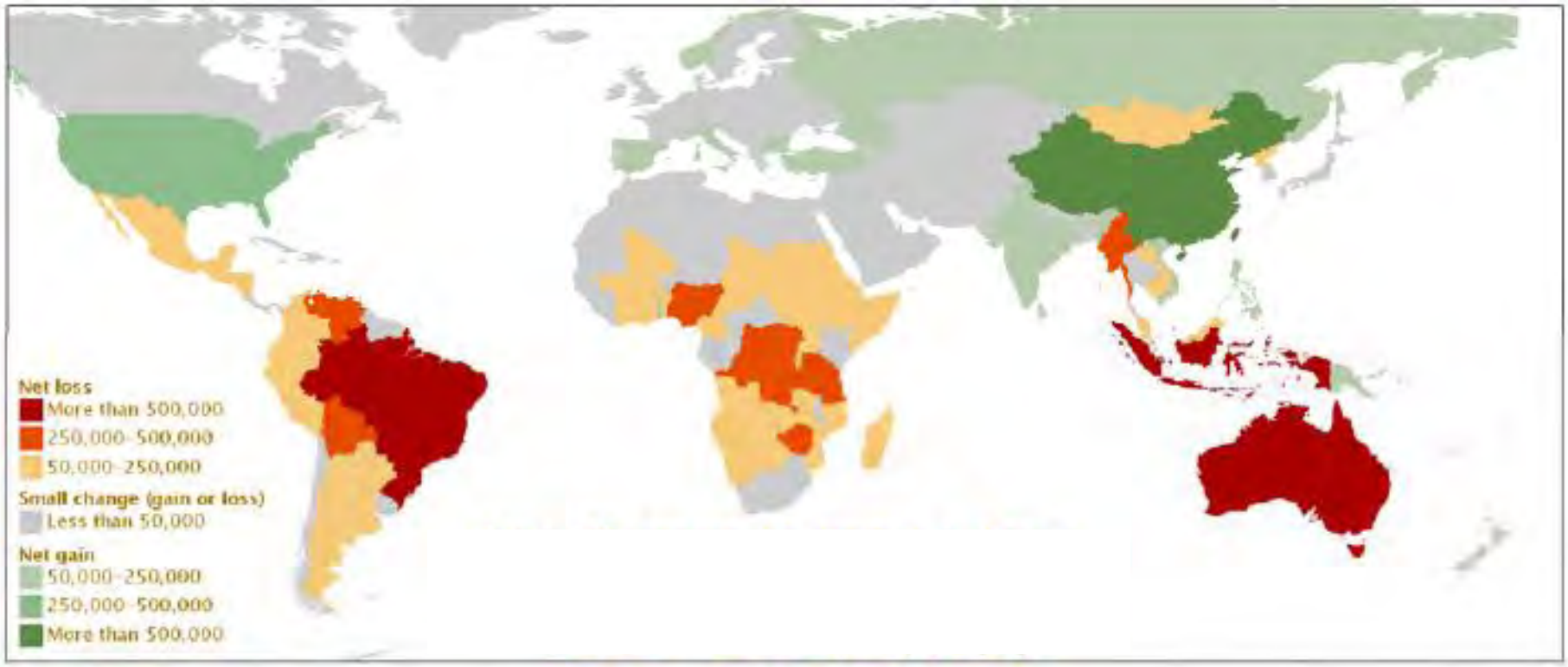
No

↓

Loss of carbon? → Yes → Degradation

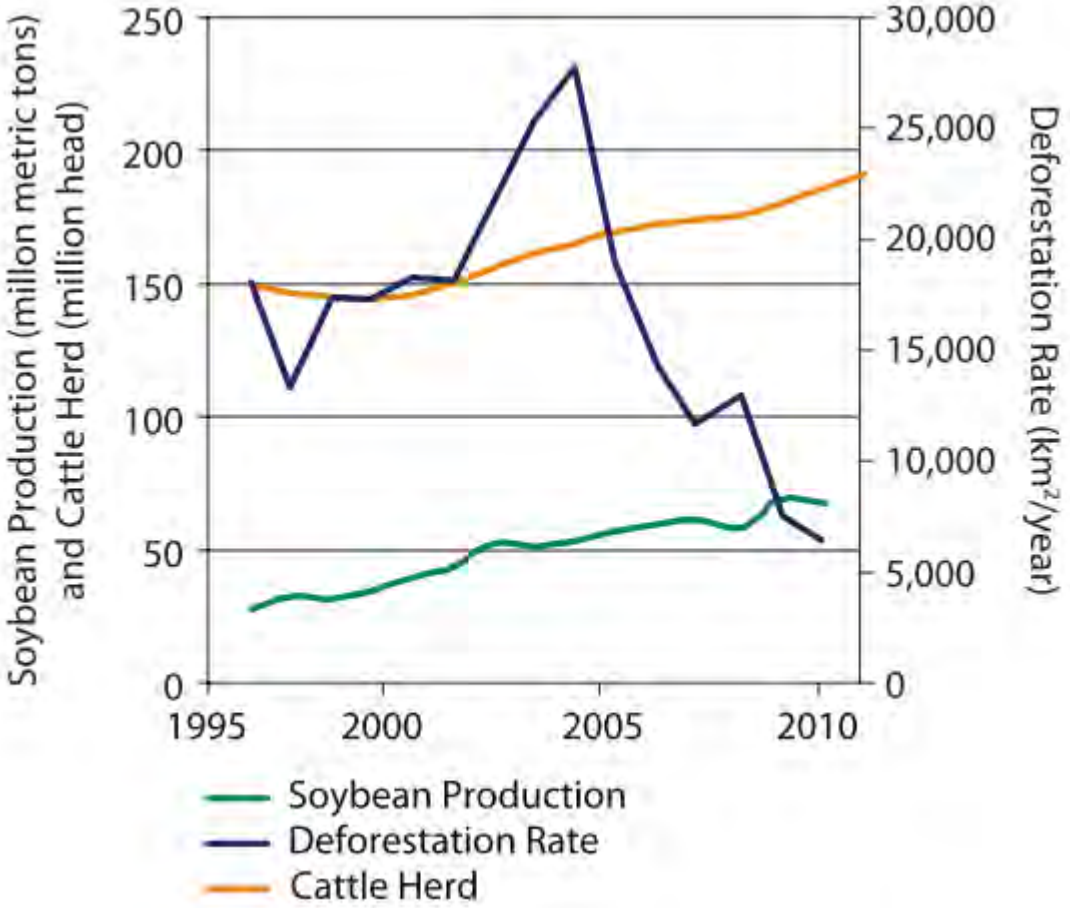


Net Change in Forest Area (ha/year) 2005-2010



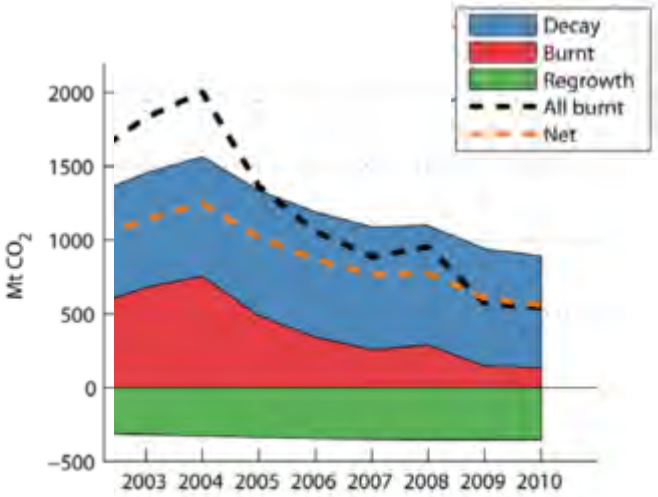
Source: FAO 2010

Deforestation & regrowth in Brazil



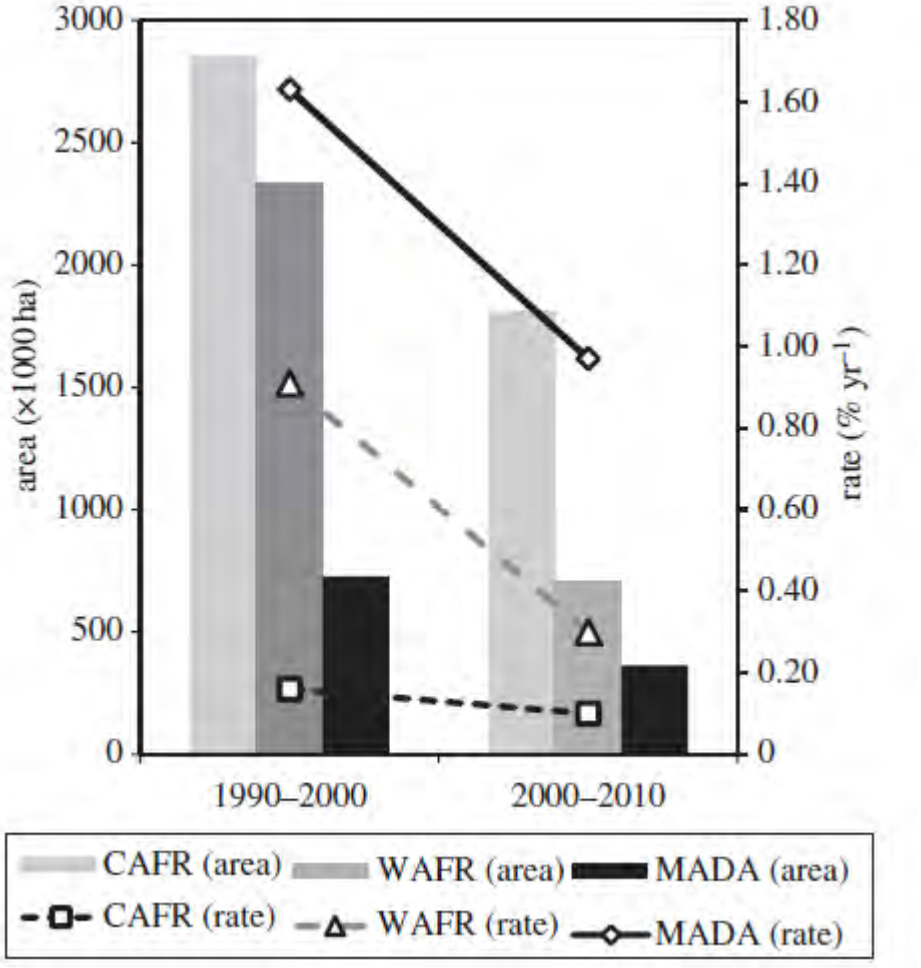
Boucher et al. 2011

Substantial regrowth



Karstensen et al. 2013

Deforestation in Africa slowing down



CAFR = Central Africa
WAFR = West Africa
MADA = Madagascar

Mayaux et al., 2013

Scenario: forest sector mitigation by 2030

- Mitigation potential
  - IPCC (2007): 1-3 Gt CO2 eq. year-1
  - Isenberg & Potvin (2010): 1.5-1.8 Gt CO2 eq. year-1
- Mitigation cost
  - 10-20 billion USD year^{-1}
- Comparison
    - Value of global carbon markets in 2010: 200 billion USD year^{-1}
    - Annual financial flows (ODA & investments) to forestry sector in developing countries: 12-24 billion USD year^{-1}
    - Forest sector ODA 0.5-1.5 billion USD year^{-1} (about 1% of the total ODA)

Eligible REDD+ Actions

… policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (UNFCCC Decision 2/CP.13–11).

Reduced emissions from:

- Deforestation
- Forest degradation

And the role of

- Conservation
- Sustainable management of forests
- Enhancement of forest carbon stocks

Scope of REDD+

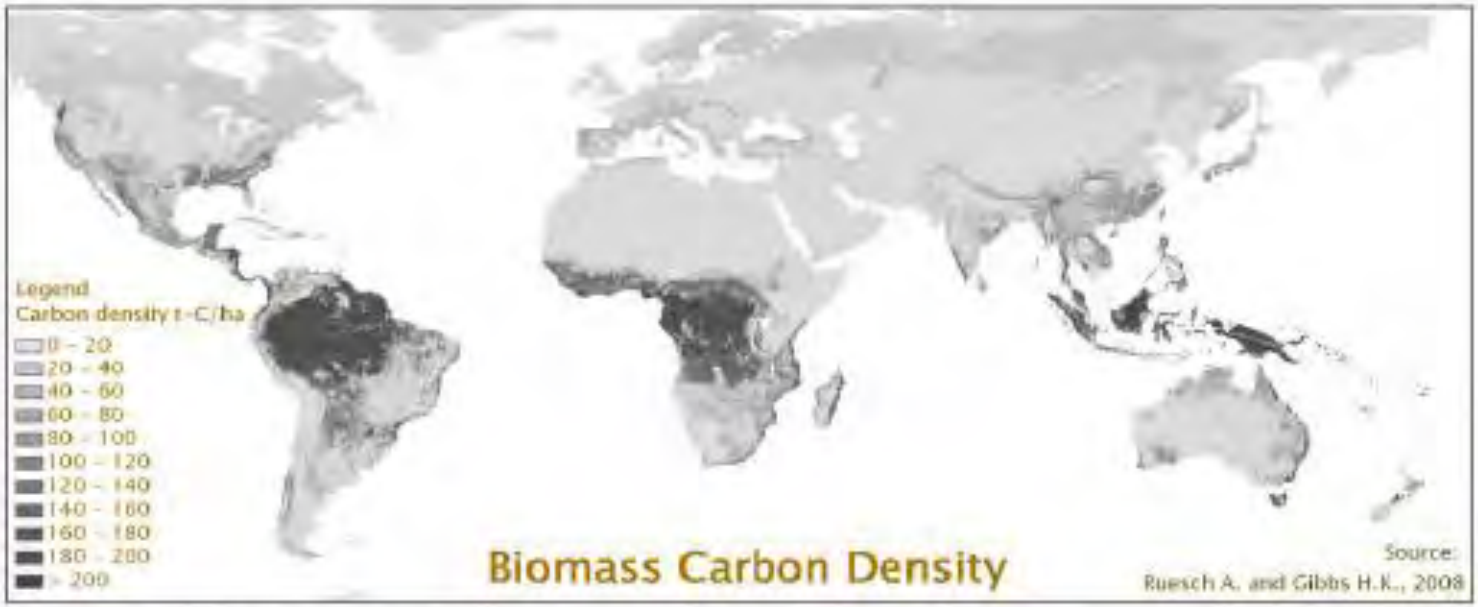
Forest carbon (C) = Forest Area (ha) * Carbon Density (C/ha)

Changes in	Reduce negative change	Enhance positive change
Forest area (hectares)	Avoided deforestation (RED)	Afforestation & reforestation (A/R)
Carbon density (carbon per hectare)	Avoided degradation (REDD)	Enhancement of forest carbon stocks (REDD+)

REDD+ Action	Changes in the Area	Changes in the Carbon Density
Deforestation	Reduce the area of forests, converted to other uses	If deforestation cannot be avoided, prioritize conversion to areas with low carbon density (e.g., degraded lands)
Forest degradation	Reduce the area of forests where degradation occurs	Minimize the reduction of carbon stocks in current land management practices and increase carbon stocks per unit area through through improved land management practices, e.g., through control of forest fires, etc.
Forest management	Maintain and increase area of production forest under sustainable management	Minimize the reduction of carbon stocks in forest management practices through reduced impact logging and other improved forest management practices
Forest conservation	Maintain the area of intact forests (e.g., in protected areas)	Maintain the carbon stocks in forests through effective conservation and development measures, law enforcement, land-use planning, etc.
Enhancement of forest carbon stocks	Increase area under sustainable forest and land management practices and through afforestation	Increase carbon stocks per unit area through improved land management practices, longer rotation periods, denser stocking and through forest restoration, rehabilitation of degraded woodlands, etc.

Kanninen et al. (2010)

VITRI

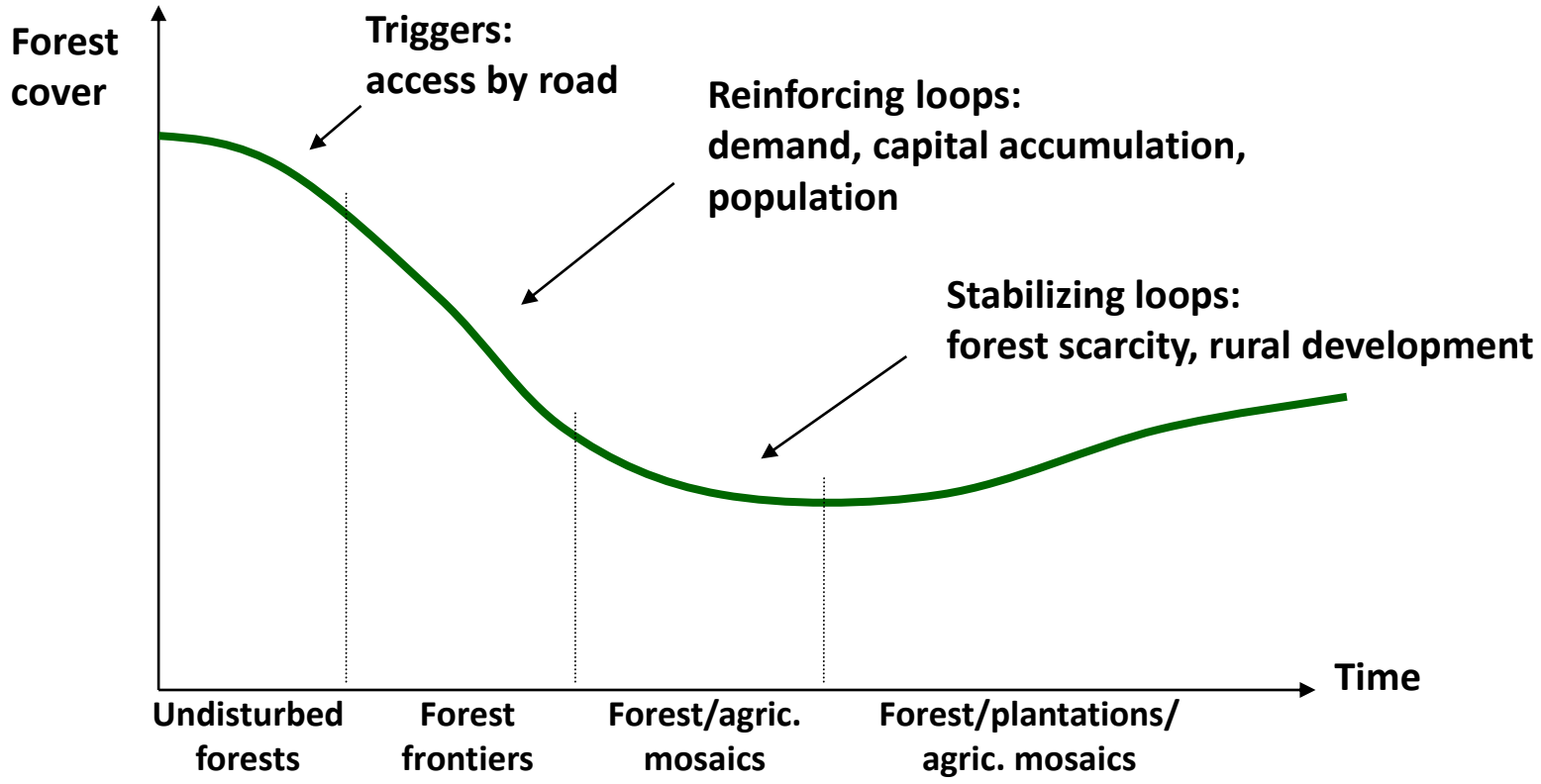

Legend
Carbon density t-C/ha
0 - 20
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
160 - 180
180 - 200
> 200
Biomass Carbon Density
Source:
Ruesch A. and Gibbs H.K., 2008


Legend
Deforestation Hotspots
Tropical Deforestation Hotspots
Source:
Achard F., Eva H., Glinni A.,
Mayaux P., Richards T.
and Stibig H.J. 1998

Forest cover and percentage of trees on farms

Source data: FAO, ICRAF

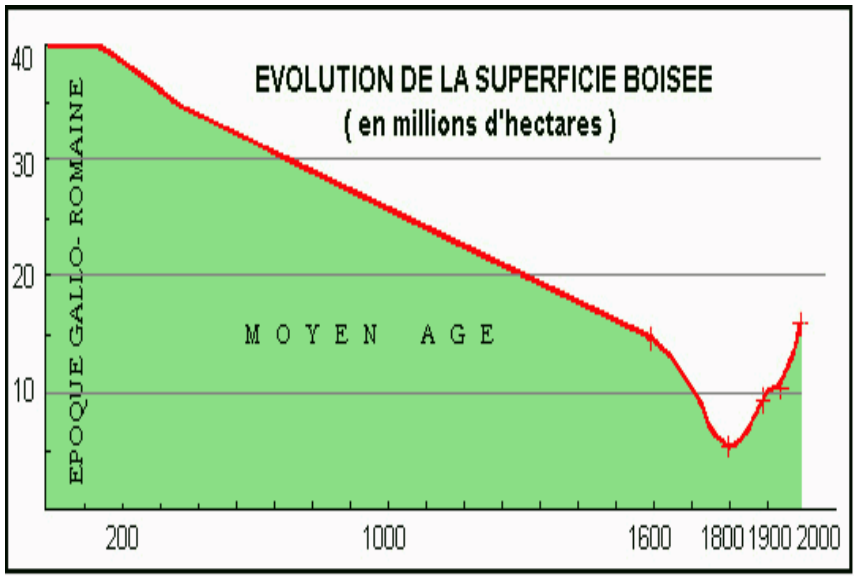
Forest transition



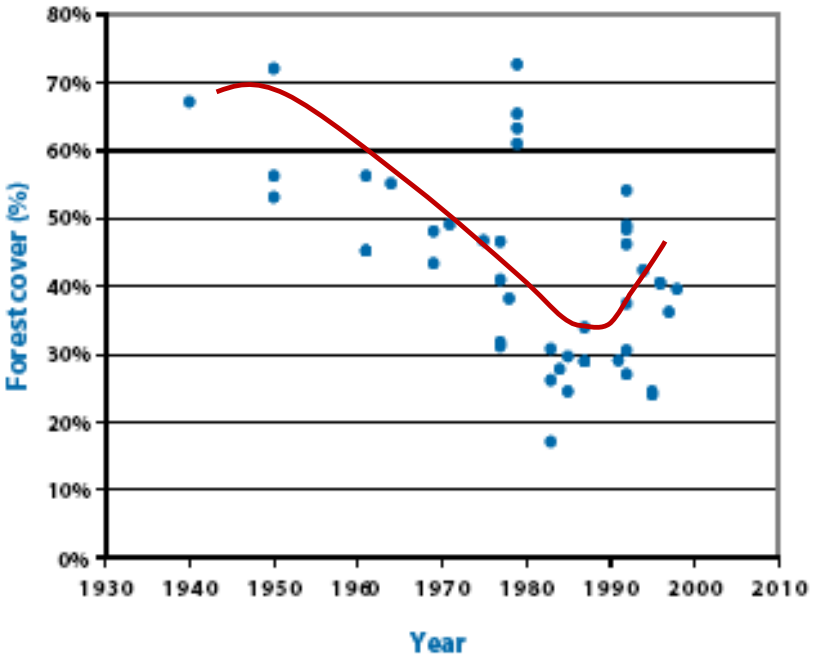
Mather and Needle 1998

Forest transition: France and Costa Rica

France (0-2000)

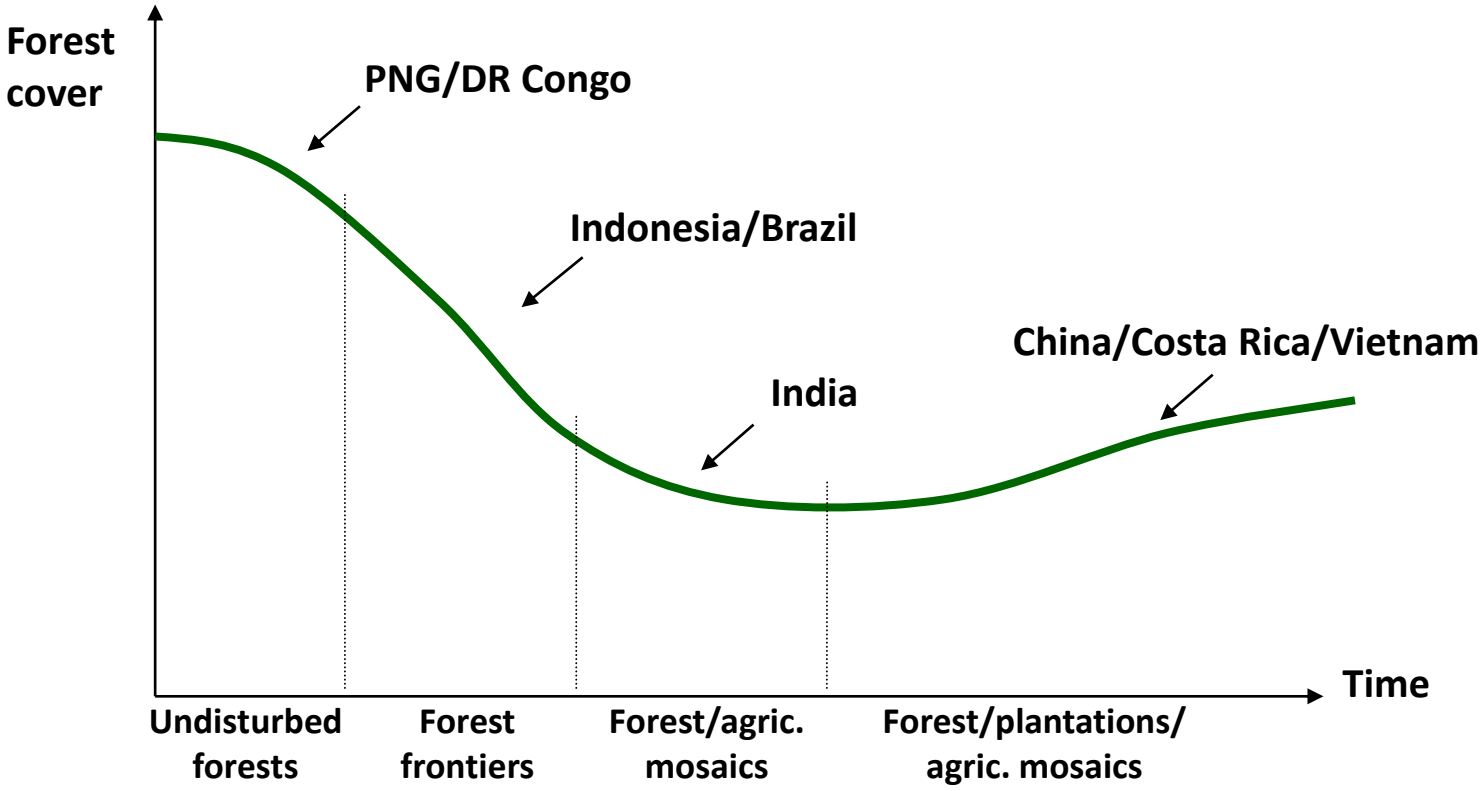


Costa Rica (1930-2000)



Kleinn et al. 2002

Forest transition



Kanninen et al. 2007

Drivers of deforestation

Direct causes

- Agricultural/bioenergy expansion
- Wood extraction/ logging
- Infrastructure development

Underlying causes

- Demographic factors
- Macroeconomic factors
- Governance factors
- Political factors
- Technological factors
- Cultural factors

Drivers of forest degradation

- Unsustainable forest management and logging practices
- Over-exploitation of fuel wood and non-timber forest products
- Large-scale and open forest fires
- Charcoal production, forest grazing etc.

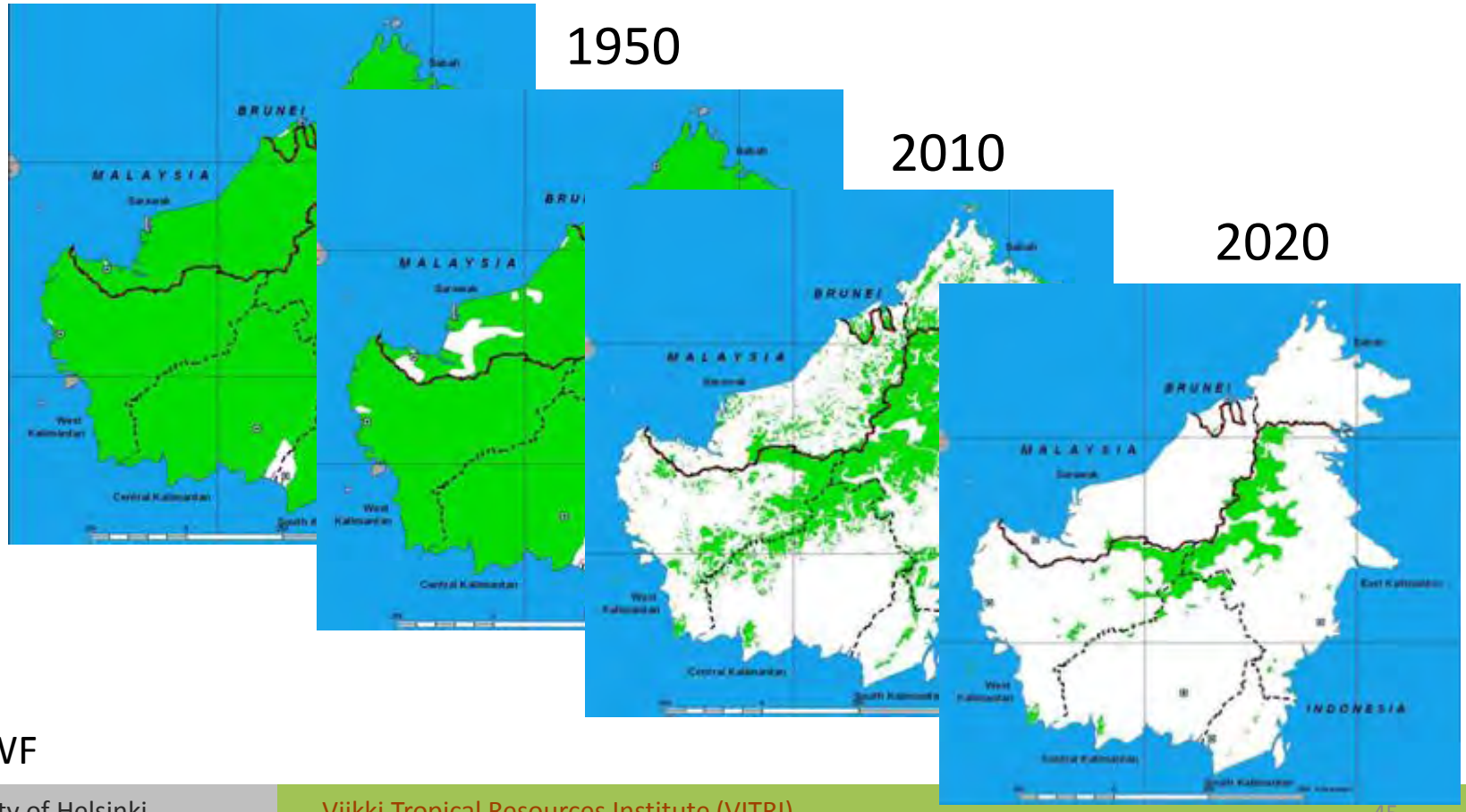
Forest area in Borneo 1900-2020

1900

1950

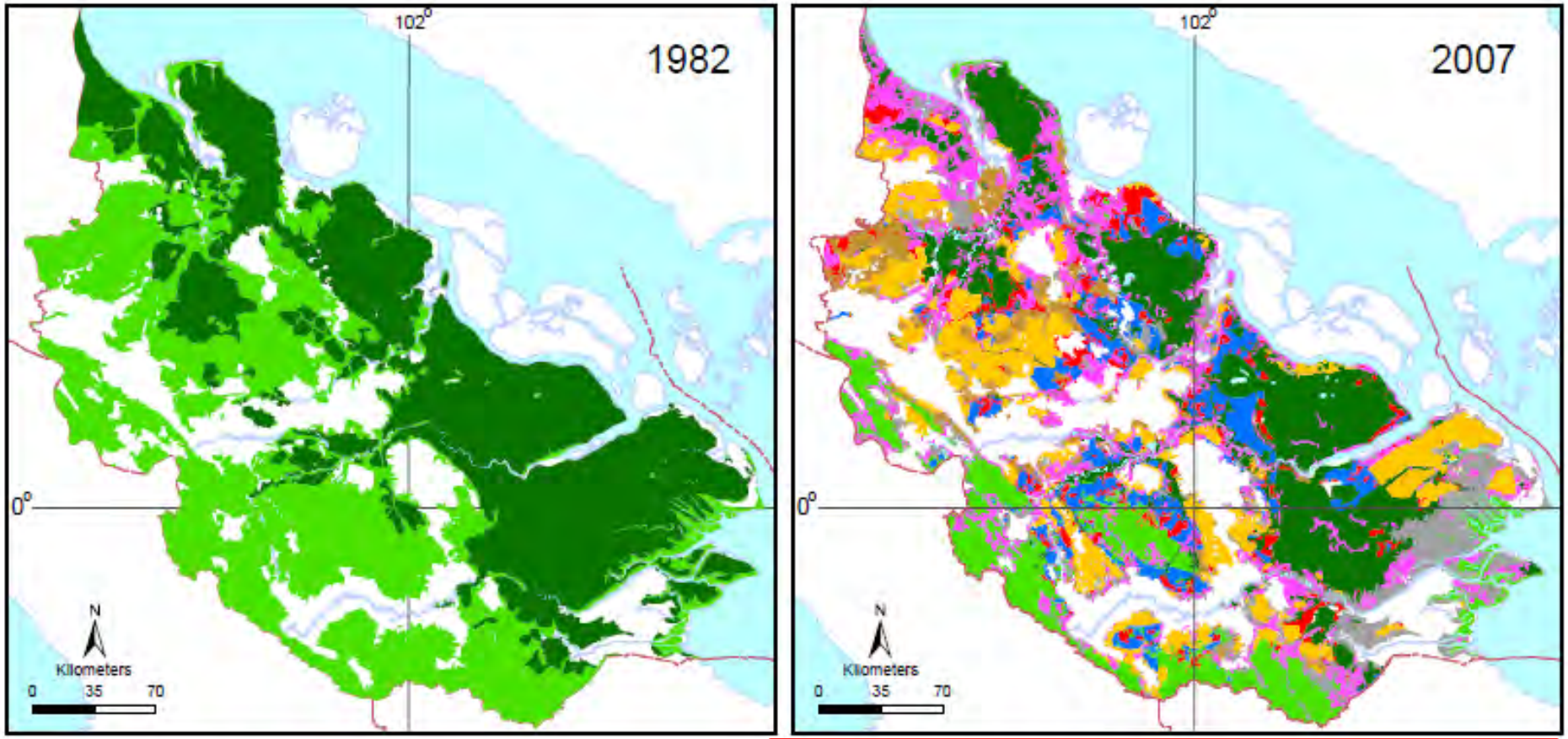
2010

2020



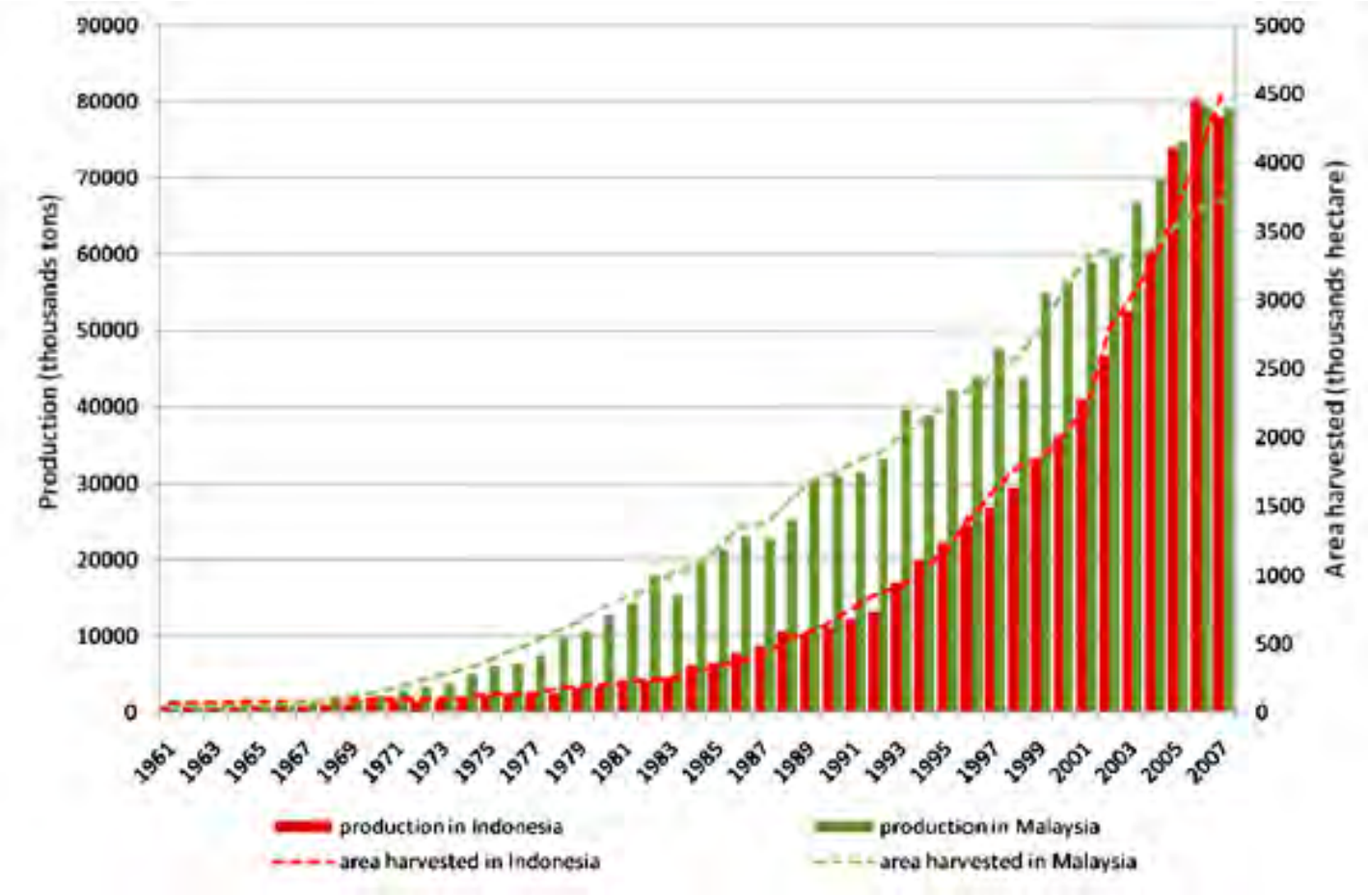
Source: WWF

What replaced natural forests? 1982-2007
WWF Land Cover Database Riau, Indonesia



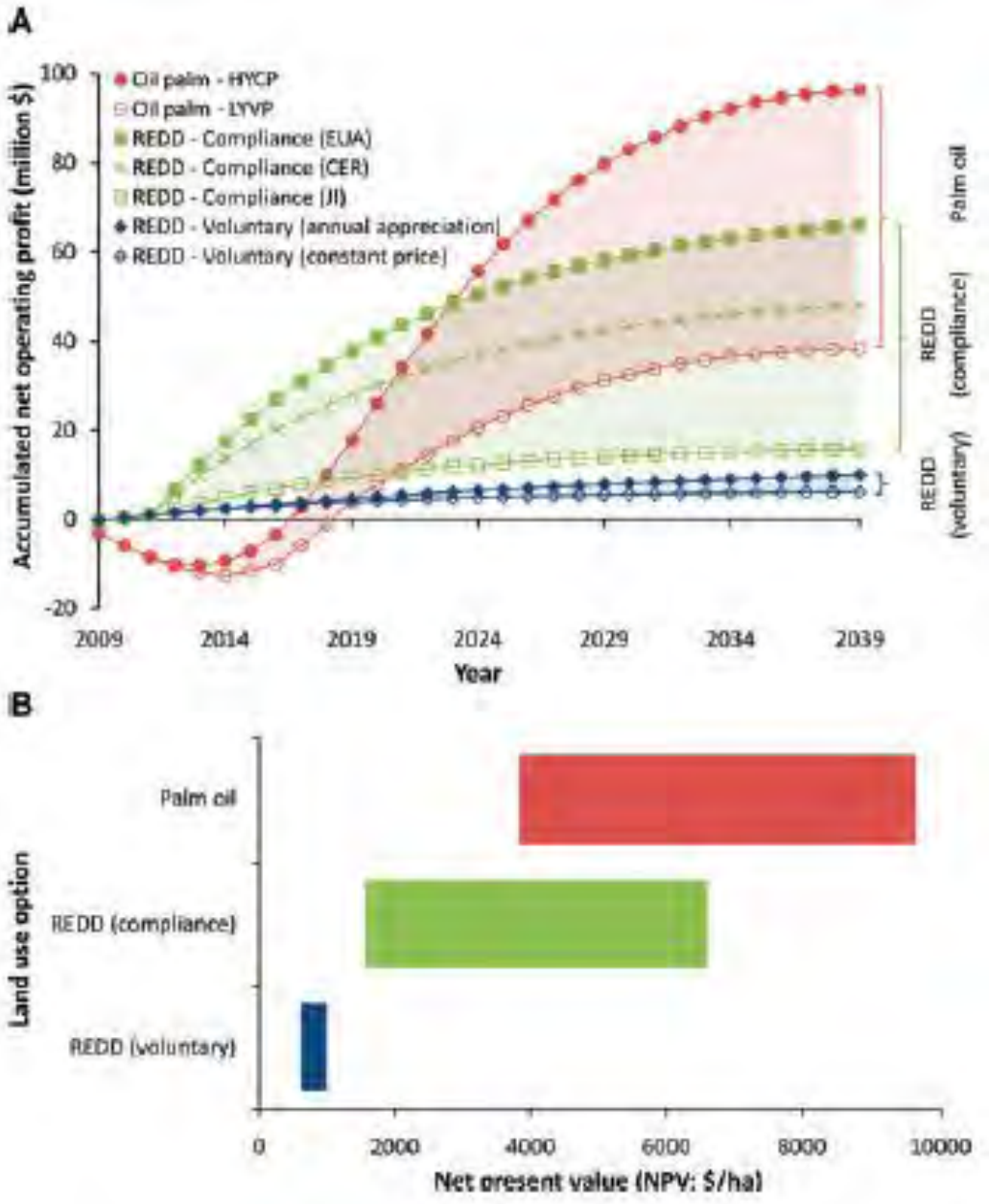
Uryu et al. 2008

Oil-palm plantations in Indonesia and Malaysia



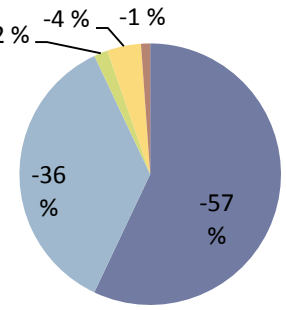
Murdiyarso & Kanninen 2008

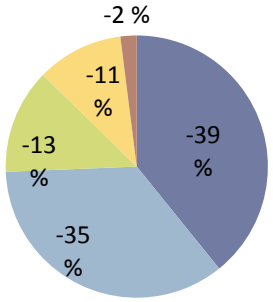
Oil palm is hard to beat

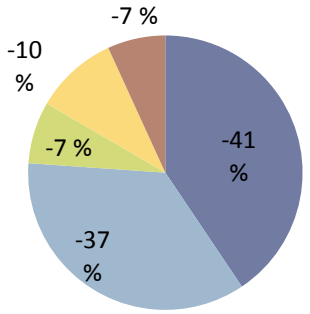


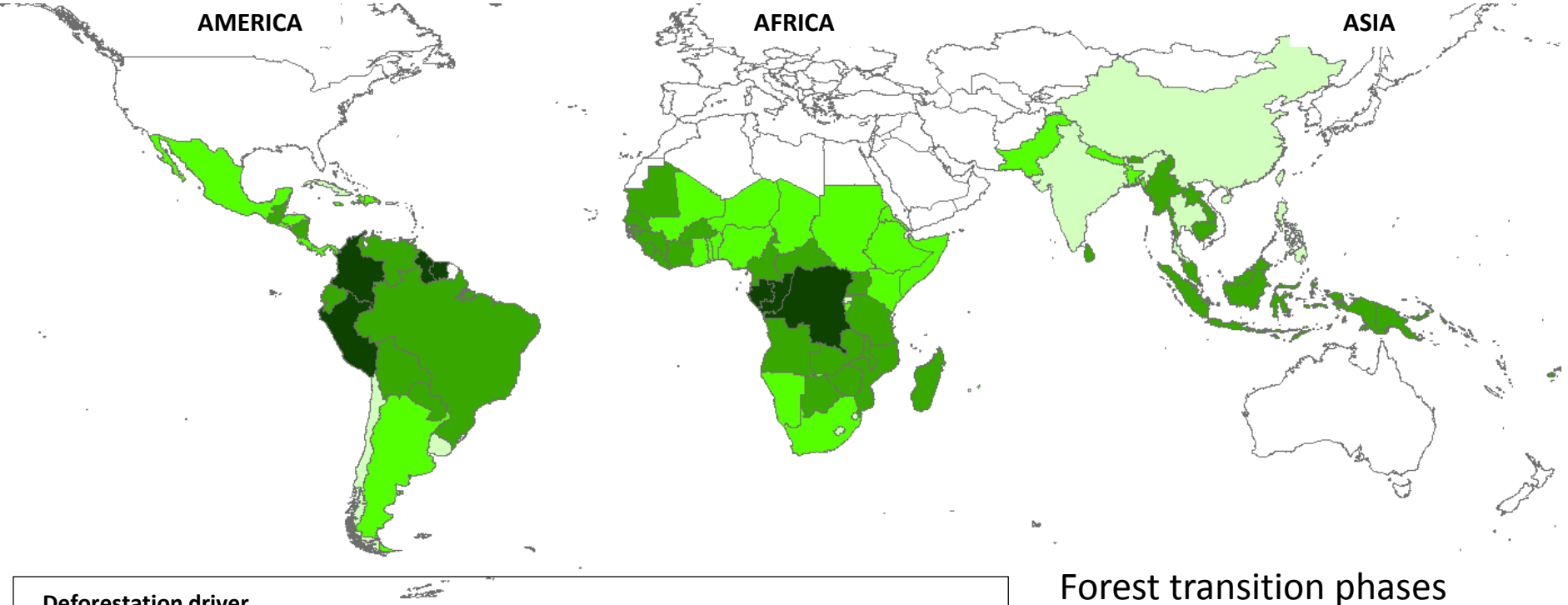
Source: Butler et al. 2009

Drivers of deforestation and forest degradation









Deforestation driver

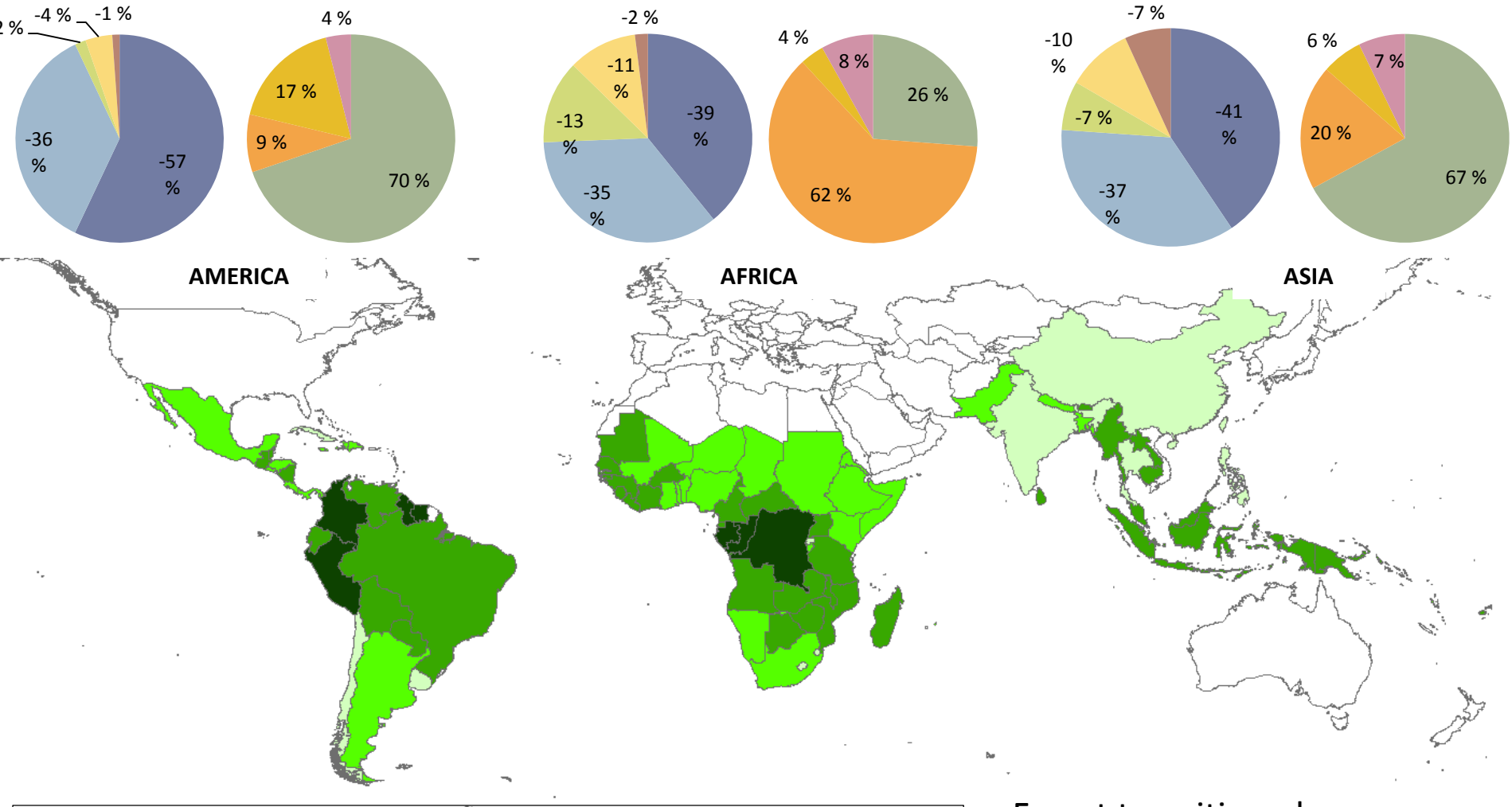
- Agriculture (commercial)
- Agriculture (local-slash & burn)
- Mining
- Infrastructure
- Urban expansion

Forest transition phases

- Pre
- Early
- Late
- Post

Hosonuma et al. (in press)

Drivers of deforestation and forest degradation



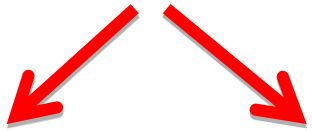
Hosonuma et al. (in press)

Drivers of deforestation and forest degradation

- Major <u>deforestation</u> drivers for all 3 continents are commercial and local/subsistence agriculture (~ 83 %)
- Major <u>degradation</u> drivers for American and Asian continent is timber/logging which account for almost 70% of total, on the other hand fuel-wood/charcoal are the main driver for African continent
- Contributions of different proximate drivers vary for continents and different forest transition phases – can be used as proxy to estimate for countries with no data!?
- Impact for monitoring: each deforestation/degradation process requires specific monitoring in particular for the use of remote sensing

Hosonuma et al. (in press)

Two-track approach to REDD+



TRANSFORMATIONAL REFORMS

- Tenure reform
- Governance
- Decentralization

→ *may or may not in itself lead to REDD+*
→ *but positive effects on equity and poverty reduction, which is necessary for the long-term success of REDD+ efforts*

SPECIFIC POLICIES

- Payments for Ecosystem Services
- Community-based NRM
- Agricultural policies
- Energy policies
- Land use restrictions
- Sustainable forest management

→ *Sectorial, simpler*

(Angelsen et al., 2009)

Enabling REDD+ through broad policy reforms & safeguards

- Tenure and rights - critical
  - Essential for long-term success of REDD+
  - Some ”no regret” REDD policies available
- Corruption
  - Puts a severe limit, in some cases very difficult to address (systemic institutional changes needed)
  - Monitoring (MRV) of both carbon and financial flows can reduce risks
- Safeguards
  - Risk reduction: risk of local rejection, social conflict
  - Transparent and effective national forest governance structures
  - Conservation of natural forests and biological diversity and enhancement of other social and environmental benefits
  - Consistency with objectives of national forest programs and relevant international conventions and agreements

Why might REDD+ succeed?

- Volume of finance might be sufficient to shift the political economy of drivers of deforestation and degradation
  - 10-20 Billion USD year^{-1} to halve the deforestation by 2030
- Strong political attention and engagement at the national level
- Alignment of the interests of multiple constituencies – part of the "climate deal"
- Flexible financing schemes: performance-based markets combined with fund-based schemes

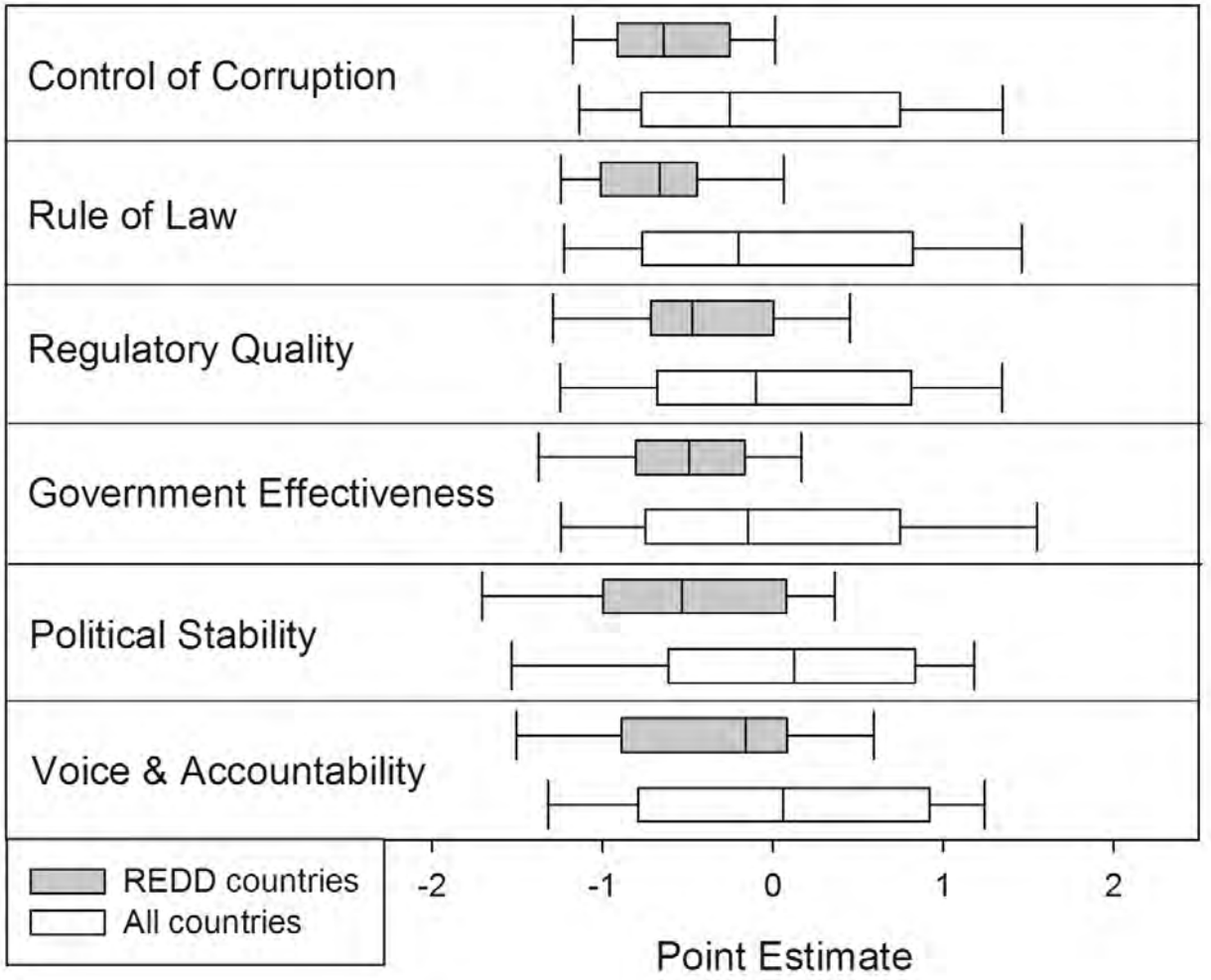
Why might REDD+ fail?

Main barriers:

- For participating in REDD+:
  - Weak institutions and governance structures
  - Conflicts (e.g. central vs. local governmentetc.)
  - Lack of human and institutional capacity
- For successful REDD+:
  - Those above
  - Political economy – underlying causes of deforestation
  - Lack of transparency, corruption

Governance gap

Data:
World Bank's six Governance Indicators in the "REDD Readiness" countries of the FCPF
(n= 37) and in all the countries (n = 212)
Source data: Kaufmann et al. (2009).



Kanninen et al. 2010

MRV Capacity Gap in 99 countries

Currently only few countries with good forest stock and change data

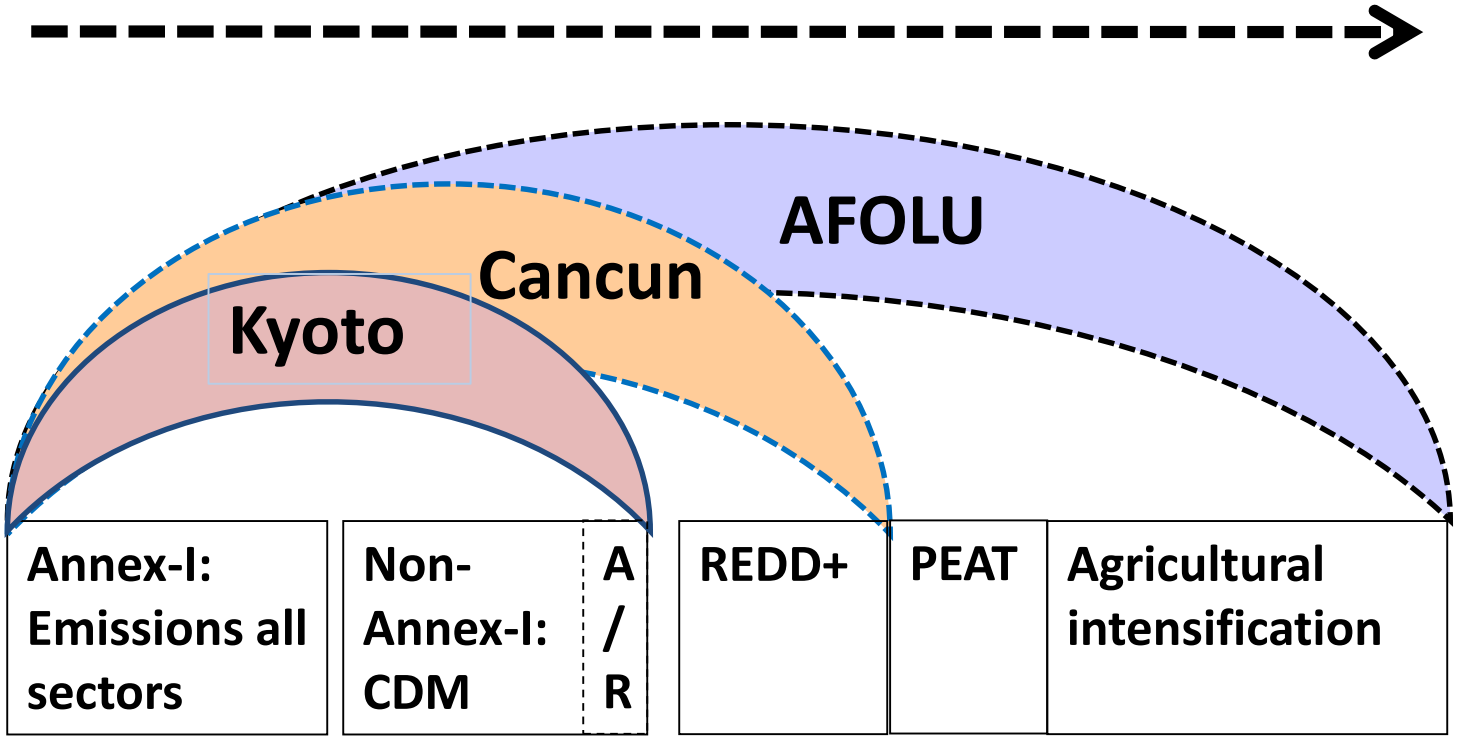
Romijn et al., 2012

Phased approach

	Phase 1 - Readiness	Phase 2 – Policies and Measures	Phase 3 – Payments for Ecosyst. Serv.
Scope	RED/REDD/REDD+	REDD/REDD+	REDD+
Crediting scale	Subnational	Nested	Nested or national
Performance indicators	- Strategy adopted - Consultations conducted	- Strategy implemented - Policies enacted - proxies for forest carbon changes	- Quantified forest carbon changes (tCO2) compared to reference level
Funding	Readiness support Fund-based *e.g. FCPF, UN-REDD, bilateral initiatives*	Fund-based *e.g. FIP, Amazon fund, voluntary C-markets*	Primarily market-based, but global fund also possible *e.g. C-markets*

Angelsen (ed.) 2008

Widening scope of accounting emissions from land-use



Non-accountable footprint: Wood products, biofuel, agroproducts

AFOLU = agriculture, forestry and land-use

Conclusions

- REDD+: part of a global climate change regime
  - Warsaw 2013 decisions
  - National circumstances and priorities
  - Effectiveness, efficiency, and equity
- Overshooting climate targets – adaptation needed
  - Adaptation becomes crucial for sustainable development
- Mitigation needs adaptation (= synergies)
  - Adaptation is essential to protect future mitigation potential of forests
- Research to analyze
  - Drivers of change (dynamics), barriers of adoption,
  - Synergies (win-win), trade-offs
  - Links between forests and sustainable development and adaptation
  - Linking adaptation and mitigation

Thank you very much
for your attention

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