



REGIONAL OVERVIEW

Ecosystem Conservation and Restoration

Identifying drivers of land use change In South America

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Outline



- Land-use change, deforestation and degradation
- Drivers of deforestation and forest degradation
- Analysis and assessment of drivers in South American countries
- Going deeper: Analysis of landscape transformation in tropical Latin America and implications for development and conservation

Sources of information used for this presentation

Caspari T., S. Alexander, B. ten Brink and L. Laestadius. 2013. Review of Global Assessments of Land and Ecosystem Degradation and their Relevance in Achieving the Land-based Aichi Biodiversity Targets - A technical report prepared for the Secretariat of the Convention on Biological Diversity (SCBD).

Grau, H. R., and M. Aide. 2008. Globalization and land-use transitions in Latin America. *Ecology and Society* 13(2): 16. [online] URL: <http://www.ecologyandsociety.org/vol13/iss2/art16/>

FAO. 2010. Global Forest Resources Assessment 2010. Main report. FAO Forestry Paper 163.

FAO. 2013. FRA 2015 Terms and definitions. Forest Resources Assessment Working Paper 180.

Foley J.A. 2005. Global Consequences of Land Use. *Science* 309, 570 (2005); DOI: 10.1126/science.1111772.

Hosonuma N., M. Herold, V. De Sy, R.S. De Fries, M. Brockhaus, L. Verchot, A. Angelsen and E. Romijn. 2012. An assessment of deforestation and forest degradation drivers in developing countries. *Environ. Res. Lett.* 7 (2012) 044009 (12pp)

Kissinger G., M. Herold and V. De Sy. 2012. Drivers of Deforestation and Forest Degradation. A Synthesis Report for REDD+ Policymakers. Lexeme Consulting, Vancouver Canada, August 2012.

Nelson G.C. et al. 2006. Anthropogenic Drivers of Ecosystem Change: an Overview.

Ecology and Society 11(2): 29. [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/art29/>

Pacheco P., M. Aguilar-Støen, J. Börner, A. Etter, L. Putzel and M.C. Vera Diaz. 2011. Landscape Transformation in Tropical Latin America: Assessing Trends and Policy Implications for REDD+. *Forests* 2011, 2, 1-29; doi:10.3390/f2010001

Simula M. 2009. Towards defining forest degradation: comparative analysis of existing definitions. Forest Resources Assessment Working Paper 154. September 2009.

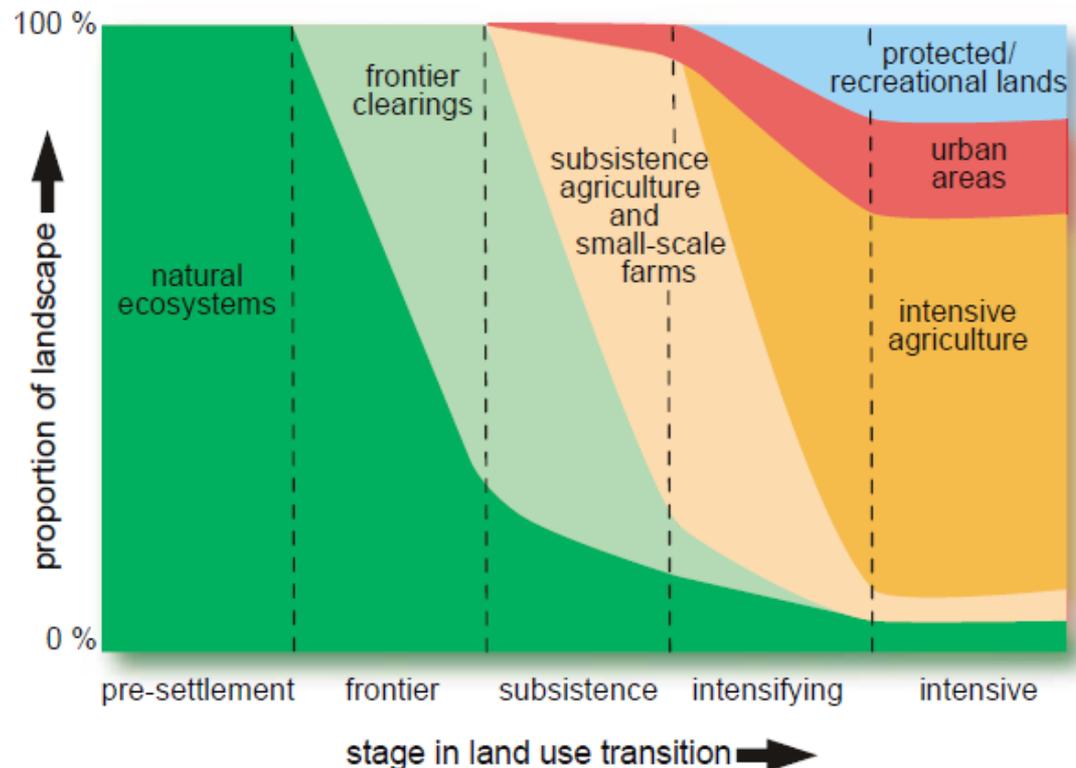
LAND USE CHANGE, DEFORESTATION AND DEGRADATION

Land use change

→ Change in the use or management of land by humans, which may lead to a change in land cover *(IPCC Fourth Assessment Report)*

- A process by which human activities transform the landscape

- **Land clearing / degradation** is the most visible direct effect of land use change
- **Transitions in land use** activities that may be experienced within a given region over time *(Foley et al. 2005)*



Deforestation

FRA definition (FAO 2013): The conversion of forest to other land use or the long-term reduction of the tree canopy cover below the minimum 10 percent

Explanatory notes:

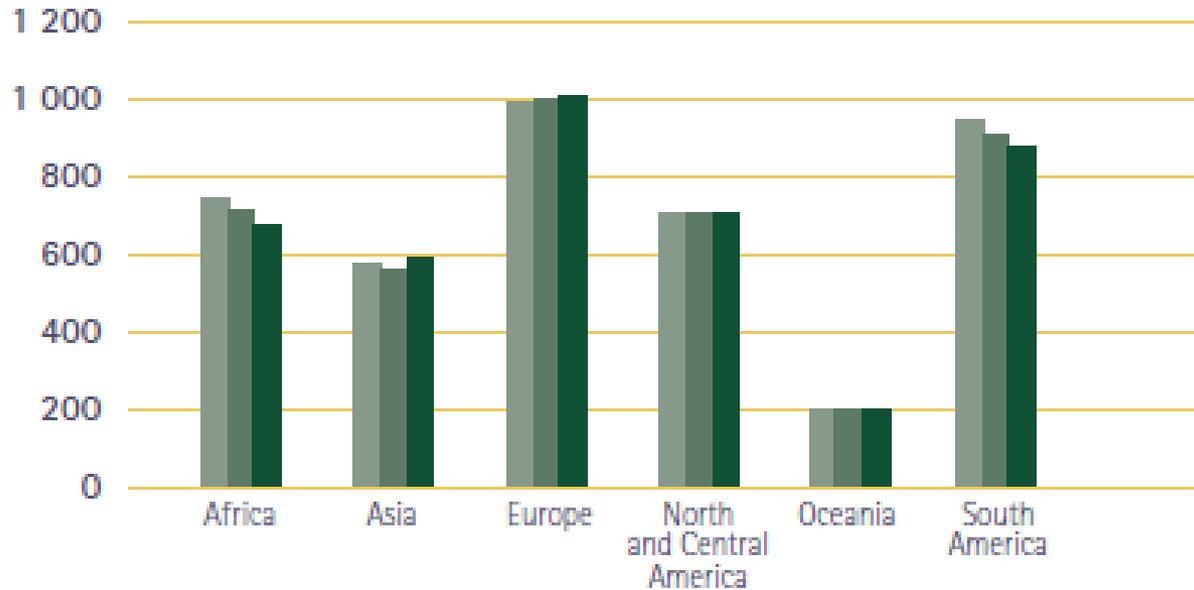
- Deforestation is the long-term or permanent loss of forest cover and transformation into another land use
- It includes areas of forest converted to agriculture, pasture, water reservoirs, rangeland and urban areas
- The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures



FRA (2010): Changes in forest area in South America

Trends in forest area, 1990-2010 (million ha)

■ 1990 ■ 2000 ■ 2010



**Forest cover in
2010: 864.351 M
ha** (49% of land area)

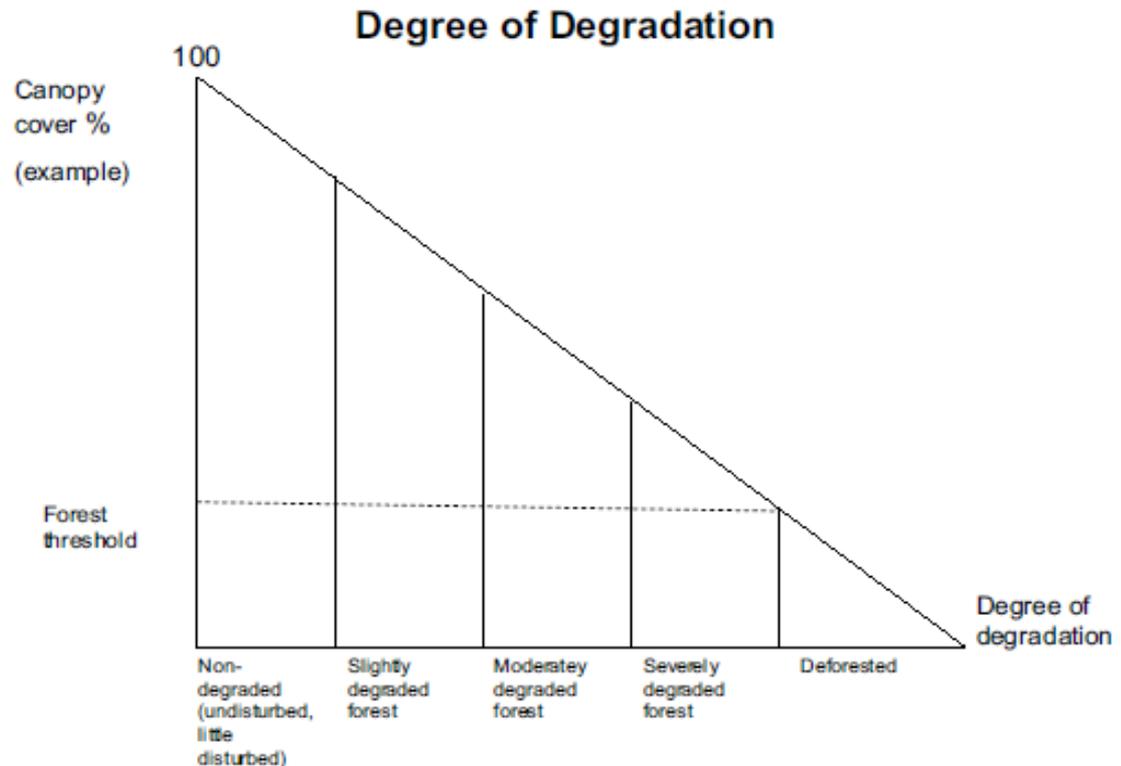
South America and Africa continue to have the largest net loss of forest

- *Global deforestation: 0,13 % per year*
- *Deforestación in South America: 0,45 % per year*

Degradation

CBD definition: Any combination of loss of soil fertility, absence of forest cover, lack of natural function, soil compaction, and salinization that either impedes or retards unassisted forest recovery through secondary succession (*UNEP/CBD/SBSTTA/11/INF/2*)

- **Land degradation** : a state and process, characterized by a loss or reduction in ecological or economic productivity (*Caspari et al. 2013*)
- **Forest degradation** : the reduction of the capacity of a forest to provide goods and services (*FRA 2013*)



The process of forest degradation can be abrupt or a slow gradual process

Forest degradation estimates

⇒ *Review of Global Assessments of Land and Ecosystem Degradation and their Relevance in Achieving the Land-based Aichi Biodiversity Targets - Caspari et al. 2013*

- Most of the existing data on degradation refer to the extent and rate of ecosystem conversion, rather than degradation
- **Globally:** 21.8% of land area converted to human-dominated uses or *production landscapes*
 - about 1/3 of total land area converted to agricultural land, including permanent pasture
- **Study of forest landscapes**
(Laestadius et al. (2012):
 - **Degraded = 27 %** (1,459 M ha)
 - **Fragmented = 52 %** (2,814 M ha)
 - **Intact forest = 21 %** (1,112 M ha)



DRIVERS OF DEFORESTATION AND FOREST DEGRADATION

- **Driver** → Any natural or human-induced factor that directly or indirectly causes a change in an ecosystem *[Millennium Ecosystem Assessment]*
- **Categories of drivers** *(Nelson et al. 2006)*

Direct drivers

Physical and biological drivers:

- Climate variability and change
- Plant nutrient use *(nutrient application to agricultural systems)*
- **Land conversion**
- Biological invasions and diseases

Drivers interact across spatial, temporal, and organizational scales

In some specific cases, **multiple direct drivers work in combination**

Indirect drivers

→ Demographic drivers

Population dynamics and primary determinants of population change: fertility, mortality, and migration

→ Economic drivers

Consumption, production and globalization

→ Sociopolitical drivers

Forces that influence decision making in the large conceptual space between economics and culture

→ Cultural and religious drivers

→ Scientific and technological drivers

Drivers of deforestation and forest degradation *(Hosonuma et al., 2012)*

Direct drivers of DEFORESTATION

Agriculture (commercial)	<ul style="list-style-type: none">– Forest clearing for cropland, pasture and tree plantations– For both international and domestic markets– Usually large to medium scale
Agriculture (subsistence)	<ul style="list-style-type: none">– For subsistence agriculture– Includes both permanent subsistence and shifting cultivation– Usually by (local) smallholders
Mining	<ul style="list-style-type: none">– All types of surface mining
Infrastructure	<ul style="list-style-type: none">– Roads, railroads, pipelines, hydroelectric dams
Urban expansion	<ul style="list-style-type: none">– Settlement expansion

Direct drivers of FOREST DEGRADATION

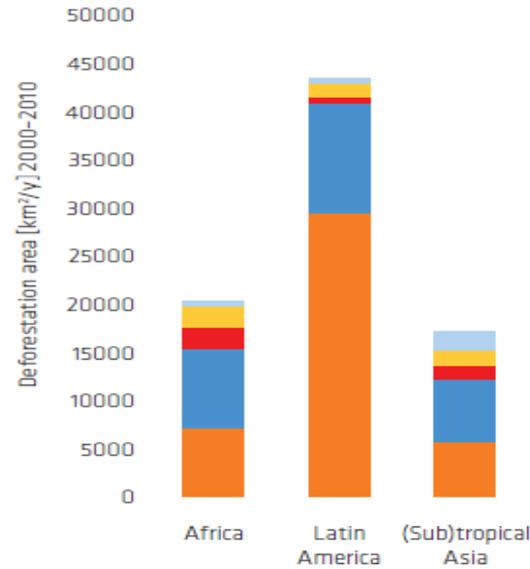
Timber/logging	<ul style="list-style-type: none">– Selective logging– For both commercial and subsistence use– Includes both legal and illegal logging
Uncontrolled fires	<ul style="list-style-type: none">– Includes all types of wildfire
Livestock grazing in forests	<ul style="list-style-type: none">– On both large and small scales
Fuelwood/charcoal	<ul style="list-style-type: none">– Fuelwood collection– Charcoal production– For both domestic and local markets

Continental-level estimations of relative importance of deforestation and forest degradation drivers (Hosonuma et al. 2012)

a) Proportion of deforestation drivers



b) Area proportion of deforestation drivers



c) Proportion of forest degradation drivers



In Latin America

- Urban expansion
- Infrastructure
- Mining
- Agriculture (local / subsistence)
- Agriculture (commercial)

- Livestock grazing in forest
- Uncontrolled fires
- Fuelwood charcoal
- Timber logging

Commercial agriculture (including livestock) → the most important driver of deforestation (~ 2/3 of total deforested area)

Commercial timber extraction and selective logging → main drivers of forest degradation (more than 70%)

○ **Pressures from many international (indirect) drivers to clear forests are expected to increase in future** due to: *(Kissinger et al. 2012)*

- global urbanization
- increasing developing country prosperity
- changing food consumption patterns (meat-based diets)
- growth in developing country regional markets for key commodities
- long-term population trends
- climate change adaptation factors

- ***No one size-fits-all*** --- As drivers of D&D operate at sub-national, national, regional, and global scales, so too must strategies and interventions aiming to affect them, engaging actors at various scales



Availability of data is an issue !!

- Data to assess the drivers is not easily available
- Difficulties to establish clear links between underlying factors and deforestation/degradation patterns

Options for monitoring approaches and data sources of the main forest change activities and drivers on the national level *(Kissinger et al. 2012)* – EXAMPLES:

Activity/Driver of deforestation and forest degradation	Indicator for mapping	Common sources for activity data (on national level)	Common data sources for emission factors/ estimations (on national level)	Examples of other data on proxies and for accessing underlying causes
Commercial agricultural clearing for cattle ranching, row crops etc.	Large clearings; post-clearings land-use	Historical satellite data for deforestation area and land-use following deforestation	Traditional national forest inventories/ ground measurements	<ul style="list-style-type: none"> ▪ Commodity prices ▪ Agriculture census ▪ Agriculture GDP, export etc.
Subsistence agriculture , small-holder farming and shifting cultivation	Small clearings, often rotational fallow cycles	Historical satellite data for determining area and rotation pattern	Traditional national forest inventories/ ground measurements and targeted surveys Efforts to assess long-term net emissions	<ul style="list-style-type: none"> ▪ Population growth in rural and urban areas ▪ Agriculture imports/exports ▪ Land-use practices (i.e. rotation cycles etc.)

Analysis and assessment of drivers in South

American countries

(Hosonuma 2012, Kissinger et al. 2012)

Summary of the main country reported information on direct and indirect drivers

COUNTRY	DIRECT DRIVERS	INDIRECT DRIVERS
ARGENTINA <i>(FCPF June 2010)</i>	<ul style="list-style-type: none">○ Industrial/ commercial soybean○ Biofuel (<i>new threat</i>)○ Livestock production (<i>expected to increase</i>)	<ul style="list-style-type: none">○ Climate change○ Increased international demand and prices for certain commodities○ Insufficient law enforcement○ Change of scale and increased availability of capital associated with the emergence of crops consortia○ Macro-economic factors
BOLIVIA <i>(UN-REDD March 2010)</i>	<ul style="list-style-type: none">○ Agricultural expansion○ Illegal forest activity○ Infrastructure (electrification, oil exploration & extraction, roads)○ Fires○ <u>Degradation</u> mostly from domestic logging (incl. firewood) and legal and illegal forest sector activity	<ul style="list-style-type: none">○ Inobservance of land use legislation○ Agricultural incentives (policy, subsidies)○ Weak forestry sector○ Governance and enforcement○ International demand for agricultural/ wood products/ bio-fuels○ Demographic growth○ Corruption

CONT. Country reported information on direct and indirect drivers

COUNTRY	DIRECT DRIVERS	INDIRECT DRIVERS
CHILE <i>(FCPF R-PIN Jan 2012)</i>	<ul style="list-style-type: none"> ○ Fuel wood extraction ○ Illegal logging ○ Livestock production 	<ul style="list-style-type: none"> ○ Weak institutions ○ Socio-cultural and economic barriers – land tenure and rural poverty
COLOMBIA <i>R-PP (FCPF September 2011)</i>	<ul style="list-style-type: none"> ○ Agricultural expansion (legitimate and illicit) ○ Livestock ○ Settlement ○ Infrastructure ○ Mining ○ Illegal logging 	<ul style="list-style-type: none"> ○ Population growth ○ Migration ○ Market trends ○ Land speculation ○ Low perceived value of forests ○ Political / institutional-weak policies and governance ○ Poor land management
PERU <i>R-PP (March 2011)</i>	<ul style="list-style-type: none"> ○ Agricultural expansion (including oil palm, soybean and illegal crops) ○ Cattle raising ○ Slash and burn clearing and logging ○ Transportation ○ Energy ○ Mining infrastructure ○ <u>In future</u>: Investment plans and the pressure of illicit activities 	<ul style="list-style-type: none"> ○ Infrastructure expansion ○ Population increase ○ Poverty ○ Social exclusion ○ Lack of management control in forest concessions and in wood value chain

Analysis of deforestation in the Region

(Grau and Aide (2008))

- **Traditional shifting agriculture and cattle ranching** → historically the main drivers of deforestation, BUT
- **Export-oriented industrial agriculture** → has become the main driver of deforestation
 - **Amazon basin** → Lost the largest area to deforestation: conversion to agriculture and pastures, and increasingly to large-scale agriculture
- **Soybean production** → in extensive areas of seasonally dry forest with flat terrain: Brazil, Bolivia, Paraguay, Argentina
- **CRITICAL UNDERLYING DRIVERS** of D&D identified by countries → **weak forest sector governance and institutions**, including **conflicting policies beyond the forest sector**, and **illegal activity** (related to weak enforcement) *(Kissinger et al. 2012)*



Map of Latin America main biomes

(based on *Eva et al. 2004*), showing the **main deforestation fronts** (based on *FAO 2003* and *Gasparri et al. 2008*) and **selected case studies of ecosystems regeneration**

Grau and Aide (2008)

- 1-Petén-Chiapas
- 2-Honduras-Guatemala
- 3-Northern Nicaragua
- 4-Ecuador/Col/Vene Amazon
- 5- Southern Guyana-Rio Negro
- 6- Acre-Rondonia
- 7- Peruvian Amazon
- 8- Mato Grosso
- 9- Sta Cruz-Bolivia
- 10-NE Brazil-Caatinga
- 11-Argentine Chaco
- 12-Paraguay



- 1- Klooster 2003
- 2- Bray & Klepeis 2005
- 3- Hecht et al. 2006
- 4- Southworth & Tucker 2001
- 5- Kull et al. 2007
- 6- Wright & Samaniego 2008
- 7- Grau et al. 2008c
- 8- Lugo 2002
- 9- Rudel et al. 2002
- 10- Wieggers et al. 1999
- 11- Jepson 2005
- 12- Baptista 2008
- 13- Preston et al. 1997
- 14- Morales et al. 2005
- 15- Grau et al. 2008a
- 16- Kitzberger & Veblen 1999
- 17- Moran et al. 1996
- 18- Perz & Skole 2003

CASE STUDY: ANALYSIS OF LANDSCAPE TRANSFORMATION IN TROPICAL LATIN AMERICA

(Pacheco et al. 2011)

- Focus on **productive landscapes** and the groups of producers and extractors associated with them
- **Changing policies and market environments** have influenced the development of tropical forest landscapes in Latin America by shaping opportunities and constraints for social actors



... Landscape transformation in tropical Latin America *(Pacheco et al. 2011)*

<u>Types of social actors</u>	<u>Land-use management</u>	<u>Main type of land-use</u>
INDIGENOUS PEOPLE	Forest-based activities and shifting agriculture	Forest resources extraction and shifting agriculture
TRADITIONAL SUBSISTENCE SMALLHOLDERS	Shifting agriculture and some forest extraction	Food production in restored forest fallows
SMALL-SCALE FARMERS	Small-scale sedentary agriculture	Mainly agricultural production under diversified systems
LARGE-SCALE FARMERS AND RANCHERS	Large-scale agriculture	Agricultural production under extensive or intensive systems
LOGGERS AND TIMBER COMPANIES	Logging could be linked to land- speculation goals	Selective logging and marketing of valuable timber species

Type of landscape

AGRICULTURAL LANDS DOMINATED
BY AGRIBUSINESS

PASTURE LANDS DOMINATED BY
EXTENSIVE CATTLE RANCHING

FOREST–AGRICULTURE MOSAICS
UNDER DIVERSIFIED LAND USES

FRONTIER AREAS WITH
DOMINANCE OF LOGGING

**AREAS BEYOND THE AGRICULTURAL
FRONTIER** W/ LOCAL POPULATIONS

Social actors

Medium- and large-scale **farmers**

Medium- and large-scale **ranchers**

Peasants and migrant **colonists**

Timber companies, informal
loggers and **migrant peasants**

Indigenous people and other
traditional smallholders

Exogenous and endogenous factors that define landscape type and development

- The most important **EXTERNAL FACTORS** relate to
 - **Market conditions** - national and international (e.g., volume of demand and amount of investments)
 - **Policy frameworks** (e.g., taxes, fiscal incentives, public spending on infrastructure)
- The **ENDOGENOUS FACTORS** have to do with socio-economic interactions that take place in specific landscapes, i.e.:
 - Acquisition and legitimization of **land rights**
 - **Technology adoption**
 - Development of **value chains and power relationships**
- The interactions of these two sets of factors define outset, development path and **landscape outcome**

Exogenous dynamics 'from outside'

Type of landscape

AGRICULTURAL LANDS
dominated by agribusiness

PASTURE LANDS
dominated by extensive
cattle ranching

**FOREST-AGRICULTURE
MOSAICS** under
diversified land uses

FRONTIER AREAS with
dominance of logging

**AREAS BEYOND THE
AGRICULTURAL
FRONTIER**

Trade and investment

Increasing global demand of
agricultural commodities.
Large investment in processing
and storage facilities

Increasing global consumption
of beef. Growing number of
slaughterhouses and meat-
packing plants

Expansion of niche markets
often for perennial crops

Expansion of demand for
tropical timber, and growing
links with export markets

Limited but growing markets
for non-timber forest products

Public policies

Roads improvement, availability
of cheap credit and export
incentives

Tax reduction and availability of
financial incentives

Reduced support for
colonization settlements, though
there is still some land distribution

Expansion of roads, allocation of
concessionary rights in some
cases

Increasing recognition of
collective tenure rights, mainly
for indigenous & other local people

Endogenous processes 'from inside'

Type of landscape

AGRICULTURAL LANDS

dominated by agribusiness

Development of vigorous financial and market networks, involving links with international trade corporations

PASTURE LANDS dominated by extensive cattle ranching

Adoption of improved pasture and cattle management techniques

FOREST-AGRICULTURE MOSAICS under diversified land uses

Development of non-farm economies, growing pressure on land and emigration

FRONTIER AREAS with dominance of logging

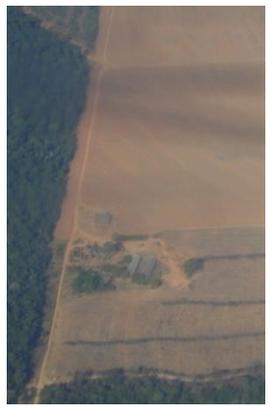
Extenuation of valuable timber species due to the adoption of selective logging operations

AREAS BEYOND THE AGRICULTURAL FRONTIER with local populations

Growing social pressures for recognition of tenure claims and provision of social services

Cuiaba-Santarém

Frontier Evolution



Opportunities and threats (Grau and Adide 2008)

- **Forest transition** occurs when
 - an economy shifts toward non-agricultural production
 - agriculture concentrates in the most productive lands, and
 - marginal agriculture is abandoned, favoring the recovery of forests and other natural ecosystems
- **Highly inefficient land-use practices** in the region have significantly reduced or transformed natural ecosystems
- **Conflict between food production and conservation** of natural and semi-natural ecosystems
- **Opportunity to achieve LU efficiency** → a **shift from traditional agriculture** (grazing pastures) **to modern agriculture** (increase in per hectare food productivity)
 - + **Policies** facilitating migration and discouraging non-competitive production systems





Gracias !!!