

# Spillovers In Deforestation

Rimjhim Saxena

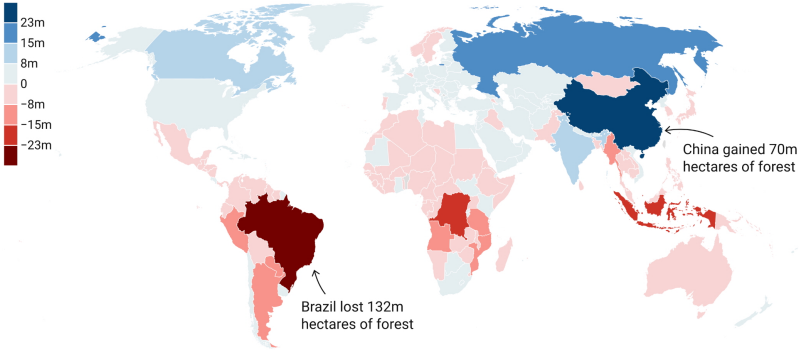
GSEM, University of Geneva

Environmental Economics and Climate Change

# Deforestation Trend

## The world is losing more forest than it gains every year

Forest area net gain (blue) and loss (red) between 1990 and 2025, in hectares



Source: Global Forest Resources Assessment 2025

## Commodity Consumption

1. Cattle
2. Palm Oil
3. Soybeans
4. Cocoa
5. Coffee

## Commodity Consumption

Commodity	Producer
Cattle	Brazil
Palm Oil	Indonesia
Soybeans	Brazil
Cocoa	Côte d'Ivoire
Coffee	Brazil

## Commodity Consumption

Commodity	Producer	EU's demand (% of global demand)
Cattle	Brazil	41%
Palm Oil	Indonesia	17%
Soybeans	Brazil	20%
Cocoa	Côte d'Ivoire	80%
Coffee	Brazil	60%

Source: Cuypers, D., T. Geerken, L. Gorissen, A. Lust, G. Peters, J. Karstensen, S. Prieler, G. Fischer, E. Hizsnyik, and H. Van Velthuisen (2013): "The impact of EU consumption on deforestation: Comprehensive analysis of the impact of EU consumption on deforestation"

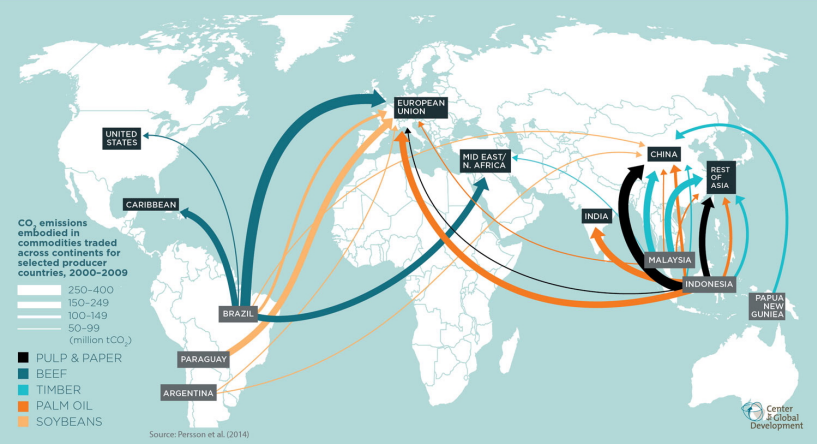
## Question

If EU forest cover is  $\uparrow$ , while the source country forest cover is  $\downarrow$

- ▶ What is happening?
- ▶ Through which channel is it happening?

# Commodity Consumption

Consuming countries share responsibility for emissions from deforestation



## Channels to consider

<b>Channel</b>	<b>Mechanism</b>	<b>Illustration</b>
<b>Market / Price</b>	Global demand or trade shocks raise agricultural prices → land expansion	EU soy demand → Brazil clearing
<b>Policy / Regulatory</b>	Protection or carbon policy in one region shifts production elsewhere	EU Deforestation Regulation → leakage to Asia/Africa
<b>Trade / Comparative Advantage</b>	Trade costs & specialization redistribute land use across countries	Brazil tariff cuts → global forest loss
<b>Structural Change / Development</b>	Income & population growth raise food demand → new clearing	Rising demand in Africa & Asia

## Global Allocative Efficiency of Deforestation (Prakash Mishra, 2025)

- ▶ If deforestation is inevitable, ideally where in the world should we deforest?
  - ▶ locations with high productivity for agriculture
  - ▶ locations with low emissions from deforestation
- ▶  $\implies$  Low yield - High emission deforestation is misallocated

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- ▶ In which situation it might not?

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- ▶ Theoretically, a pigovian tax at social cost of carbon should fix this.
- ▶ In which situation it might not?
  - ▶ consumers unable to substitute food grown in high deforestation areas (eg: Brazil) to somewhere else.
    - ▶ land might not be similarly productive everywhere
    - ▶ trade barriers exist
  - ▶  $\downarrow$ deforestation  $\implies$   $\downarrow$ ag labor demand  $\implies$  labor moves to non-ag sectors
    - ▶ what if non-ag sectors can not absorb this labor?  $\implies$  unemployment

## Global Allocative Efficiency of Deforestation (Prakash Mishra, 2025)

Layer	Decision Maker	Decision	Consideration
Plot level	Landowner	Compare Profits from Farming vs. Forest. Costs - transport, enforcement, conversion	Heterogeneity in plots. High yield but low carbon vs low yield but high carbon
Country level	Firms/Landowners (& Workers)	Domestic wages and prices	Farm prices $\uparrow$ , plots switch to ag
Equilibrium	Countries trade food & manufactured goods	Trade costs	Shocks in one region, shift land use elsewhere

# Global Allocative Efficiency of Deforestation (Prakash Mishra, 2025)

**Landowner decision**

*(plot level)*



**Domestic wages & prices**

*(country level)*



**World trade equilibrium**

*(global level)*

<b>Result</b>	<b>Intuition</b>	<b>Spillover Implication</b>
97 % of deforestation is inefficient	Low yield, high emissions land is cleared	Global carbon pricing could reallocate land use
Optimal Pigouvian tax ~ \$190 / t CO <sub>2</sub> Global output ↓7%, welfare ↑~\$6.6 trn	Internalizes global carbon externality Modest food cost, large environmental gain	Coordination cuts inefficiency Global coordination wins again
Reallocation of deforestation	From carbon-dense Amazon →lower-carbon areas	<i>Spatial spillover:</i> deforestation migrates
Partial carbon pricing →~11 % leakage	Production shifts to unpriced countries	Leakage

# Deforestation: A Global and Dynamic Perspective (FKPS, 2025)

Farid Farrokhi, Elliot Kang, Heitor Pellegrina, Sebastian Sotelo

- ▶ **RESEARCH QUESTION: How do trade, structural change, and population growth shape where and when deforestation happens? What do trade policies do to forests and welfare?**
- ▶ Four facts (1990 - 2020):
  - ▶ Global forest area ↓by 7.1% (tropics drive ~90% of loss while Europe and China regrew).
  - ▶ Deforestation and agricultural land expansion have a strong negative correlation (**incentives for land use**)
  - ▶ Countries with comparative advantage in agriculture in 1990, experienced both larger ↑in agricultural land and larger ↑in forest loss between 1990-2020 (**trade linkages**)
  - ▶ Deforestation in a country depends on its own population growth but also of its main trading partners (**trade + demand**)

## Deforestation: A Global and Dynamic Perspective (FKPS, 2025)

- ▶ They develop a quantitative model to capture all four facts.
- ▶ Location: 33 countries (7 regions). Countries differ in multiple dimensions such as productivity and endowments
- ▶ Sectors: agriculture, manufacturing, services, land-clearing sector that converts forests → usable land. Forests regrow slowly
- ▶ Households & Firms: Households consume across and within sectors, Firms use land

## Deforestation: A Global and Dynamic Perspective (FKPS, 2025)

- ▶ Equilibrium stock of land and forests are shaped by three mechanisms:
  - ▶ **Structural change:** determines the size of agricultural sector and aggregate demand for land
  - ▶ **Comparative Advantage:** distributes pressures on agricultural land and forests across countries
  - ▶ **Forward-looking land accumulation:** control the pace of forest adjustment to shocks

## Intuition Chain (FKPS, 2025)

- ▶ Every country :
  - ▶ Farms that grow crops on land
  - ▶ Factories that make goods using workers
  - ▶ Land-clearing sector that cut forest to make new farmland
- ▶ Only two available resources
  - ▶ Labor
  - ▶ Land
- ▶ Countries trade what they produce

## Intuition Chain (FKPS, 2025)

- ▶ Consumers in each country want both food and manufactured goods. They decide:
  - ▶ “How much of each do I buy?” (*depends on how substitutable they are* ( $\sigma$ ))
    - ▶ If food & manufactured goods are complements (low substitutability), people buy both even if one gets cheaper
  - ▶ “From which country do I buy them?” (*depends on how easily I can switch between countries if prices change* ( $\eta$ ))

## Intuition Chain (FKPS, 2025)

- ▶ Prices depend on:
  - ▶ How efficient the production is? (technology, soil, etc)
  - ▶ How costly it is to trade? (tariffs or trade costs)
- ▶ Farmers rent land to grow crops
- ▶ Landowners earn rent
- ▶ If farming profits  $\uparrow \implies$  rent  $\uparrow$ , land is more valuable
- ▶ Higher land value = bigger incentive to clear forest
- ▶ Forests naturally regrow but at a slow pace

## Intuition Chain (FKPS, 2025)

### A. The ( $\eta$ ) channel: Trade within Food sector

- ▶ If it becomes easier for a country to export crops, it sells more
  - ▶ more demand for its farmland
  - ▶ land becomes more valuable
  - ▶ forests get cleared faster

### B. The ( $\sigma$ ) channel: Trade between food and manufactured goods

- ▶ When all countries trade more freely, world price of food ↓
- ▶ If food and manufactured goods are complements, people don't massively shift toward food.
  - ▶ Less global demand for farmland
  - ▶ Labor moves out of farming
  - ▶ Forests can regrow

## Intuition Chain (FKPS, 2025)

Two kinds of trade frictions:

- ▶ Iceberg costs = transport inefficiency (goods melt on the way)
- ▶ Tariffs = governments collect revenue on imports.
- ▶ Lowering tariffs changes who keeps that money (farmers vs. government), so the land-clearing incentive can move differently.
- ▶ Result: sometimes cutting tariffs saves forest, sometimes it doesn't. It depends on where you start.

## Intuition Chain (FKPS, 2025)

Why dynamic?

Imagine trade liberalization as a shock:

1. Export prices change  $\rightarrow$  farmer profits rise or fall.
2. Land values adjust immediately.
3. Labor moves into or out of land-clearing.
4. Land area slowly increases or decreases.
5. Over time, forests stabilize at a new level.

It's a feedback loop that plays out over years.

Scenario	Mechanism	Forest Effect	Welfare Effect	Intuition
Unilateral ag. liberalization	Within-sector ( $\eta$ -channel)	Local deforestation	Small local gain	Higher export prices raise land rents → more clearing.
Multilateral ag. liberalization	Cross-sector ( $\sigma$ -channel)	Global reforestation (+2.5 pp)	+0.13 % income (+0.09 % net of carbon)	Lower world food prices shrink agriculture's share → less land use.

## FKPS (Farrokhi, Kang, Pellegrina & Sotelo, 2025)

Scenario	Mechanism	Forest Effect	Welfare Effect	Intuition
Global tariff removal	Tariff-revenue channel	Slight forest gain (+0.2 pp)	+0.1 %	Removing taxes has mild price impact → minor land saving.
Lower iceberg costs	Export-profit channel	Global deforestation (-0.4 pp)	Positive	Cheaper shipping boosts farm profits → more clearing.
Manufacturing liberalization	Labor reallocation	Forest gain	Positive	Labor moves from farming to industry → cropland declines.

## Key Points

1. Trade reallocates *where* land is used, not necessarily *how much*.
2. Local liberalization → deforestation; global liberalization → reforestation.
3. Type of barrier matters:
  - ▶ Iceberg = waste → removal raises clearing.
  - ▶ Tariff = tax → removal can save forest.
4. When efficient producers specialize, the planet uses less land for food.
5. Coordinated openness improves welfare **and** preserves forests.

## Conclusion

Dimension	Mishra (2025)	FKPS (2025)
<b>Focus</b>	Spatial efficiency of deforestation	Dynamic trade–population–forest interactions
<b>Spillover type</b>	Policy & price leakage	Temporal & trade spillovers
<b>Key mechanism</b>	Misallocation of clearing across plots & regions	Structural change + comparative advantage shaping land use over time
<b>Policy lesson</b>	Global carbon pricing aligns incentives	Coordinated trade liberalization curbs leakage

### Takeaway:

Deforestation is a *global coordination problem*: across **space** (who clears) and **time** (when and how economies grow). Only global carbon pricing + trade policies can align local incentives with global welfare.