The Forest Content of Global Supply Chains: Which Policy Mitigation Options?

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The forest content of global supply chains: which policy mitigation options?

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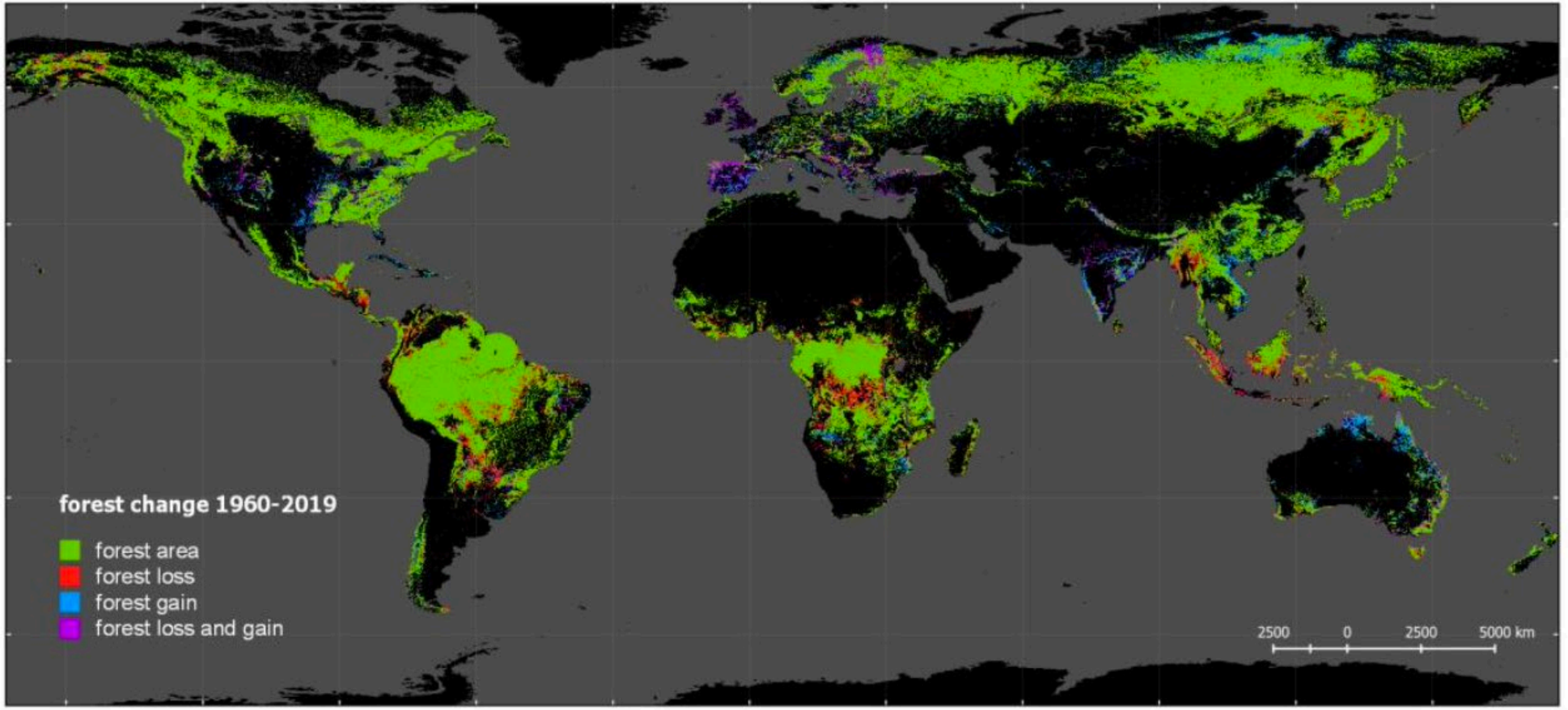
1.

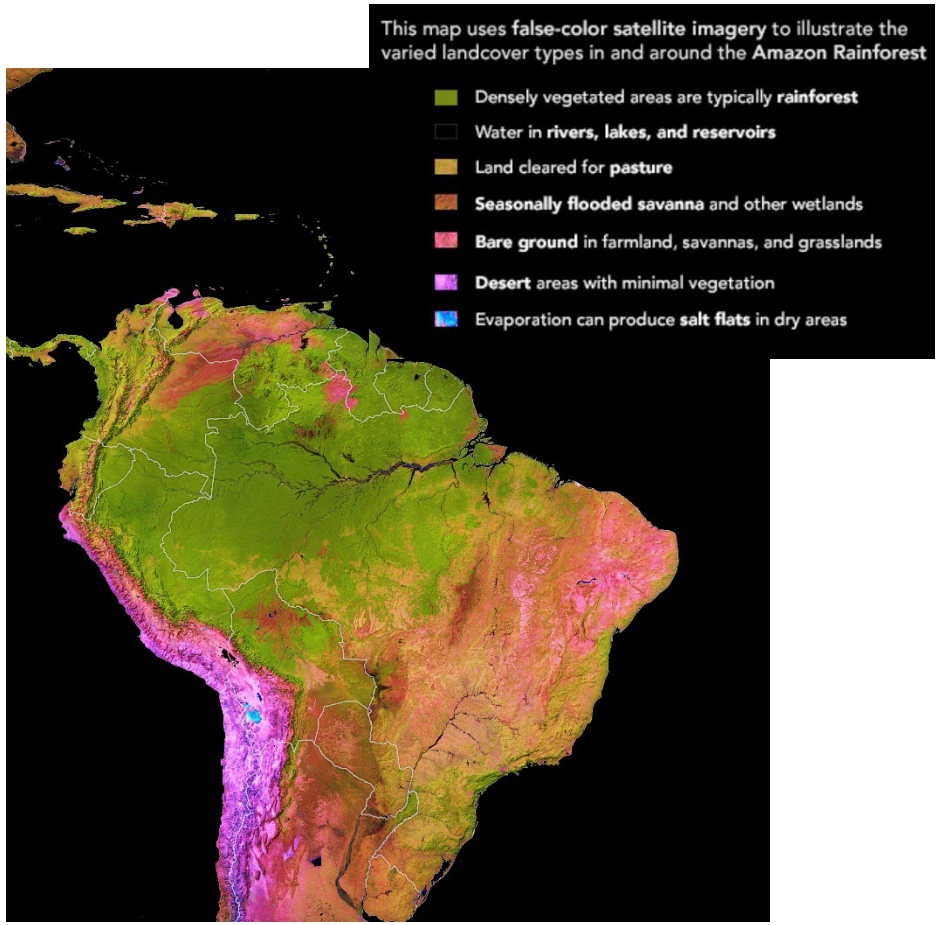
Deforestation: Quantifying the dynamics of land use change

Deforestation: what, when, and where

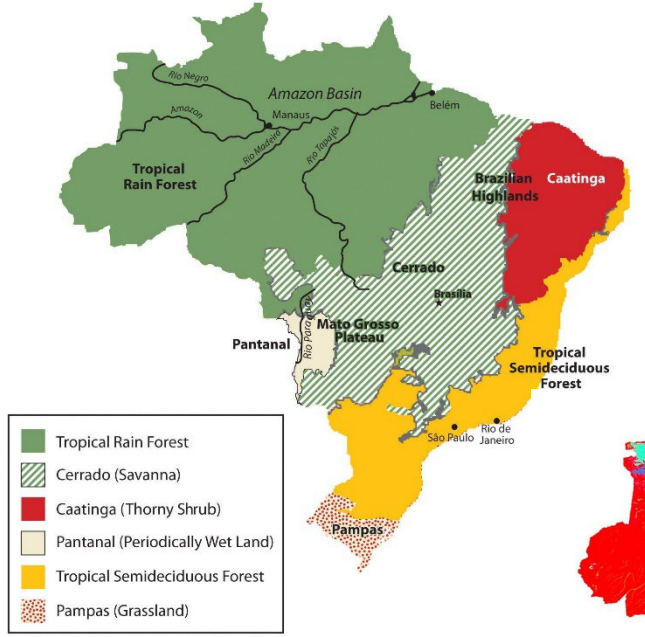


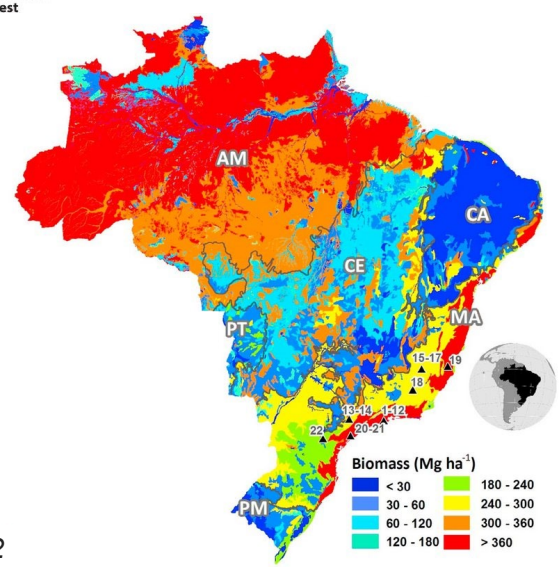
Source: Global land use changes are four times greater than previously estimated, nature communication, 2021, Winkler et al.

Deforestation: what, when, and where



Source: NASA, earth observatory website, 2018.





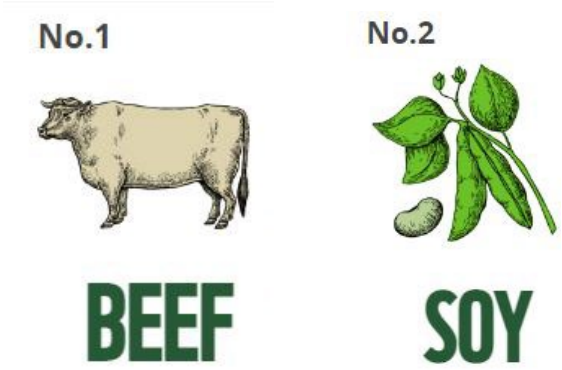
Source top: Natural Vegetation of Brazil, map collection, 2012

Source right: Historical land use change and associated carbon emissions in Brazil from 1940 to 1995, Leit et al. 2012

Deforestation: what, when, and where

The food behind deforestation

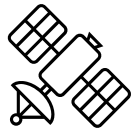
- **Beef** and **soy** production are driving more than two-thirds of the recorded habitat loss in Brazil's Amazon and Cerrado regions.
- Demand for soy is closely connected to demand for beef and other animal proteins. Between 70% and 75% of all soy becomes livestock feed



Source top: WWF, what are the biggest drivers of tropical deforestation, 2018

Measuring Deforestation: Using a combination of multiple open data streams

- Current Land Use Changes (LUC) data and their constrains.
  - Fragmented content,
  - Varying scales,
  - Lack of spatial or temporal detail,
  - and inconsistent time series.



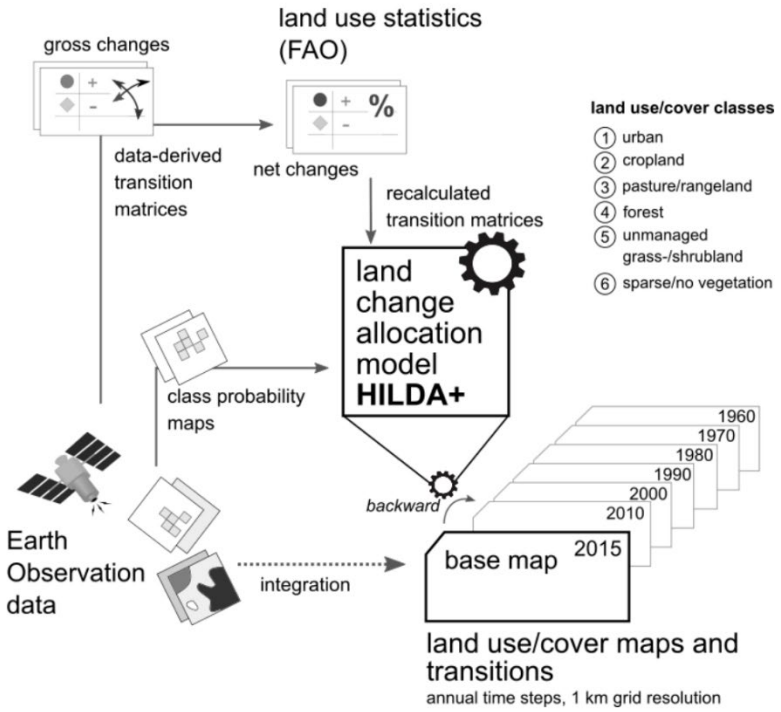
Satellite: high spatial resolution, but short temporal coverage.

Inventories and statistics: mostly concern land use: long time spans, but are bound to administrative units

- More importantly, none of the existing data on land use change fully account for gross change. In other words, all of the land transitions between LUC categories that occur during a given time period.

However, identifying gross changes in land use dynamics is essential when quantifying the climatic and environmental impact of LUC change

HIstoric Land Dynamics Assessment + (HILDA+) data



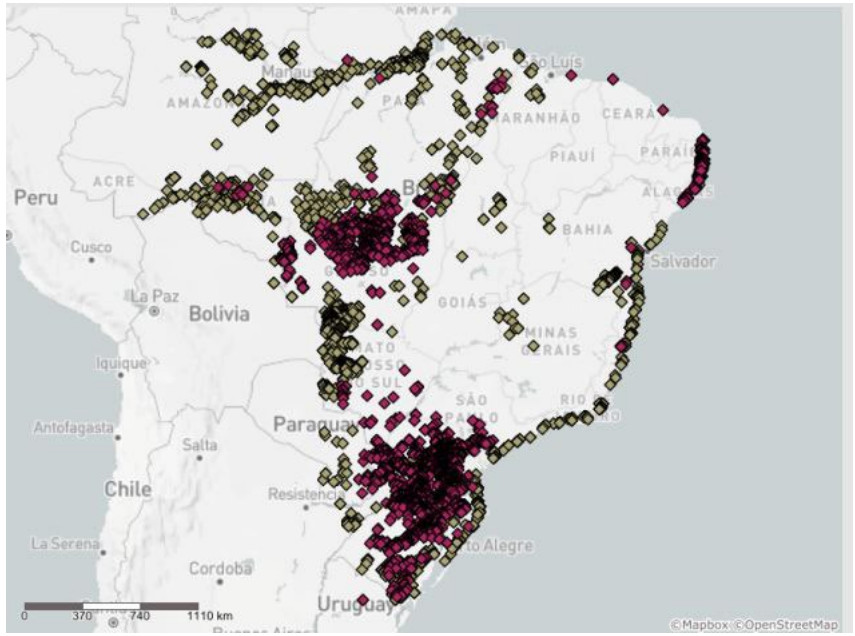
Supplementary Figure 8: Graphical overview of the HILDA+ (HIstoric Land Dynamics Assessment+) framework, a data-driven global land use/cover change allocation model.

Source: Global land use changes are four times greater than previously estimated, nature communication, 2021, Winkler et al.

- **Spatial resolution: 0.01° (~1 km)**
- HILDA+: Different Land Use/ cover categories: ocean, urban, cropland, pasture/rangeland, forest, grass/shrubland, sparse/no vegetation, water
- **Here we focus only on the annual transitions between Land Use/Cover categories:**
  - **Forest to cropland**
  - **Forest to pasture/rangeland**

Hence, we scope precisely the annual deforestation related to agricultural activities only.

Example of results



Source: Authors calculation

Region	Rural population (1000)	Avg farm size (ha)	Ranching	Sugar	Soy	Cereal	All Agriculture
			(% of rural population employed)				
Brazil	31,948	141	15	2	1	6	52
North	6178	1104	9	<1	<1	1	27
Northeast	8612	1761	21	3	<1	13	89
Southeast	6902	401	15	4	<1	2	48
South	4791	69	17	2	7	7	61
Center–West	1549	840	38	4	4	3	65

Source: IBGE (2006, 2010). Farm size calculated from a distribution of farms in various sizes. Employment proportion calculated as % of 2010 rural population data.

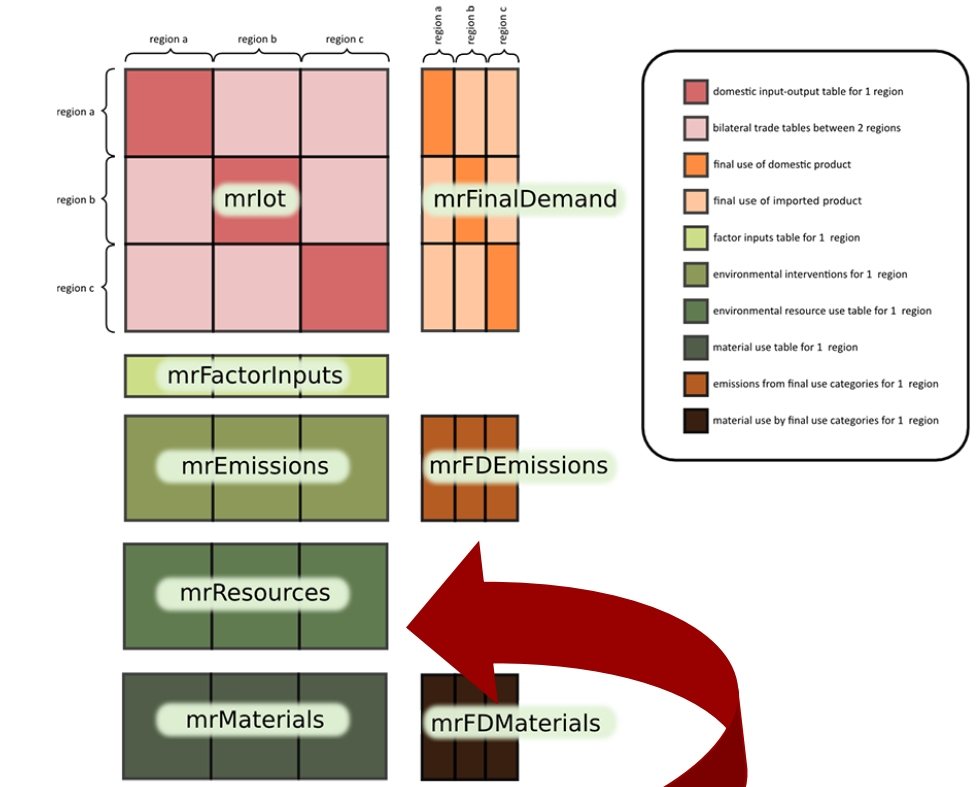
- Example of partial results of the deforestation in Brazil in 2017. Each dot has a resolution of 1 square kilometer. In red the deforestation related to cropland and in green the deforestation related to pasture.
  - Deforestation matter! (cf. biodiversity map)
  - For this illustrated year, different drivers: Cropland in the south and cropland/pasture in the north
- Different agents: in the north, large farms with small percentage of local rural employment in ranching. In the south, smaller farms with high percentage of local rural employment in sugar/soy and cereals

2.

Trade flows: Mapping the deforestation embodied in global trade

Using the Multi Regional Input Output (MRIO) EXIOBASE to map the trade flows

- We have used the Multi Regional Input Output (MRIO) EXIOBASE to map the trade flows that are embedding deforestation.
- 44 countries, 5 Rest of World regions: Brazil detailed at the country level.
- 200 products: Main Brazilian agricultural commodities detailed at the product level (soy, cattle, sugarcanes etc.)
- From 2012 to 2019. Important to have an MRIO covering several years as we are using the **annual deforestation** and it can vary a lot from one year to the other



Source: EXIOBASE website

Integration of the HILDA+ data

Using the Throughflow Based Accounting (TBA)

- **Hypothetical Extraction**
- From (Beaufils et al, under review), global externalities ***in absence*** of country c

$$HE_c = \underbrace{q.L.Y}_{\text{Global volume of externalities}} - \underbrace{q_{\bar{c}}.L_{\bar{c}}.Y_{\bar{c}.}}_{\text{Global volume of externalities In hypothetical economy without country } c}$$

- q: direct externalities (/$ of output)
- L: Leontief inverse
  $$L = (I - A)^{-1}$$
- Y: final demand

- $q_{\bar{c}}$: direct externalities from row (/$ of output)
- L: Leontief inverse without country c
  $$L_{\bar{c}} = (I - A_{\bar{c}})^{-1}$$
- $Y_{\bar{c}.}$: final demand from row

The *throughflow*

- From (Beaufils et al, under review) and based on interpretation from (Tokito et al, 2020)

$$TBA_c = HE_c = q.L.Y - q_{\bar{c}}.L_{\bar{c}}.Y_{\bar{c}}$$

Externalities embodied in supply chains

- Starting from **country *c***
- Passing through **country *c***
- Ending in **country *c***

Decomposition of the throughflow

- From (Beaufils et al, under review) and Building on (Hanaka et al, 2021)

$$TBA_c = loc_c + imp_c + exp_c + tra_c$$

Externality flow	Notation	Producer	Final user	Formula
Local externalities	loc_c	c	c	$\hat{q}_c . L . Y_c$
Imported externalities	imp_c	row	c	$\hat{q}_{\bar{c}} . L . Y_c$
Exported externalities	exp_c	c	row	$\hat{q}_c . L . Y_{\bar{c}}$
Transported Externalities (Re-exported)	$\mathbf{tra_c}$	**row**	**row**	$\hat{\boldsymbol{q}}_{\bar{\boldsymbol{c}}} . (\mathbf{L} - \boldsymbol{L}_{\bar{\boldsymbol{c}}}) . \boldsymbol{Y}_{\bar{\boldsymbol{c}}}$
*Re-imported externalities**	rei_c	c	c	$\hat{q}_c . (L - L_c) . Y_c$

**embodied in local externality flow*

Source: Beaufils et al, under review

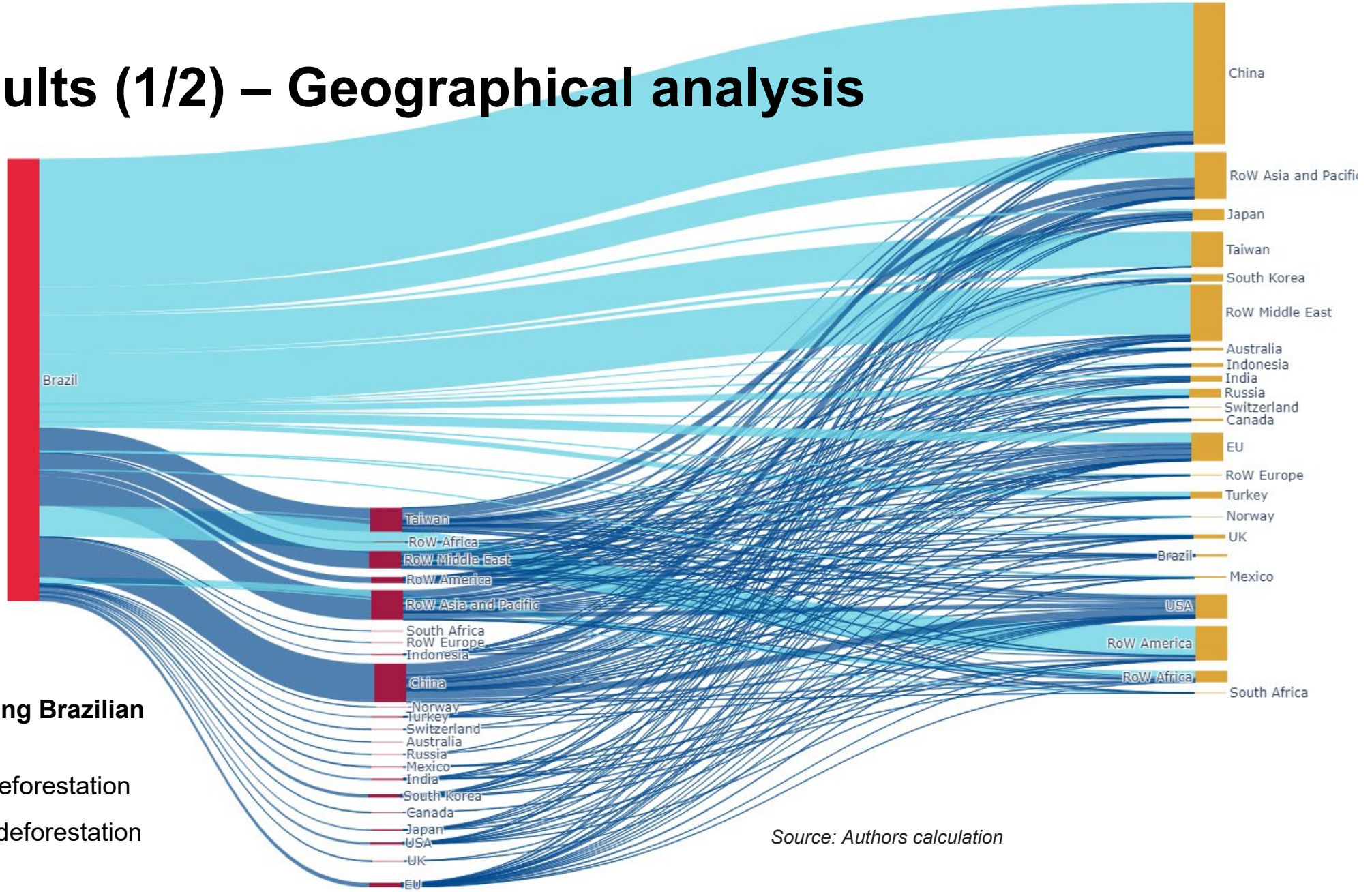
Results (1/2) – Geographical analysis

- **A significant part (av. 43% on the period 2014-2019)** of the Brazilian agricultural deforestation is related to trade with a final consumption located outside of Brazil

- If we focus more on this trade embedded deforestation, we can see that:
  - **Total**: For direct consumption and indirect consumption, China plays a major role 33%, following by the area Rest of Middle East (13%) then Rest of Asia and Pacific (13%). In fourth, fifth and sixth position Taiwan, Rest of America and EU each of them between 7% and 8%
  - **Direct vs. indirect:**
    - The part of the indirect consumption is particularly low for Taiwan (2%), China (9%), Rest of Middle East (11%), Rest of America (16%) and Turkey (23%)
    - The part of the indirect consumption is average for EU (66%)
    - The part of the indirect consumption is particularly large for USA, South Africa, Australia and Canada (each of them are above 93%)

Rest of Middle East	Egypt, Arab Rep.	Iran, Islamic Rep.	Bahrain	Iraq	Israel	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi Arabia	Palestine	Syrian Arab Republic	United Arab Emirates	Yemen, Rep.
Rest of Asia and Pacific	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan	Korea,	Mongolia	Brunei Darussalam	Cambodia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Timor-Leste
	Thailand	Vietnam	Afghanistan	Bangladesh	Bhutan	Maldives	Nepal	Pakistan	Sri Lanka	Armenia	Azerbaijan	Georgia	New Zealand	Fiji	Papua New Guinea
	Solomon Islands	Vanuatu	Kiribati	Marshall Islands	Micronesia,	Nauru	Palau	Samoa	Tonga	Tuvalu					
Rest of America	Antigua and Barbuda	Aruba	Bahamas, The	Barbados	Cuba	Curaçao	Dominica	Dominican Republic	Grenada	Haiti	Jamaica	St. Kitts and Nevis	St. Lucia	St. Vincent and the Grenadines	Sint Maarten
	Trinidad and Tobago	Belize	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Argentina	Bolivia	Chile	Colombia	Ecuador	Guyana	Paraguay
	Suriname	Uruguay	Venezuela, RB	Peru											

Results (1/2) – Geographical analysis



Trade flows embedding Brazilian deforestation:

- Light blue: direct deforestation
- Dark blue indirect deforestation

Source: Authors calculation

Results (2/2) – Sectoral analysis

	AU	BR	CA	CH	CN	EU	GB	ID	IN	JP	KR	MX	NO	RU	TR	TW	US	WA	WE	WF	WL	WM	ZA
Cattle farming	18%	72%	20%	31%	22%	37%	30%	20%	19%	21%	16%	29%	22%	70%	76%	10%	23%	39%	44%	34%	53%	69%	34%
Cultivation of cereal grains nec	11%	9%	10%	13%	2%	15%	13%	15%	14%	17%	21%	17%	12%	5%	5%	1%	13%	9%	11%	18%	10%	11%	15%
Cultivation of crops nec	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cultivation of oil seeds	55%	12%	54%	39%	72%	35%	39%	34%	47%	52%	42%	42%	50%	19%	11%	88%	50%	37%	34%	29%	17%	14%	39%
Cultivation of paddy rice	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cultivation of plant-based fibers	6%	1%	5%	7%	2%	5%	5%	22%	6%	4%	9%	4%	4%	2%	6%	0%	5%	2%	4%	3%	2%	1%	4%
Cultivation of sugar cane, sugar beet	1%	2%	5%	2%	0%	1%	1%	2%	7%	1%	1%	2%	1%	2%	0%	0%	2%	2%	3%	10%	2%	3%	3%
Cultivation of vegetables, fruit, nuts	0%	1%	2%	2%	0%	2%	6%	0%	1%	0%	0%	1%	5%	0%	0%	0%	1%	0%	1%	0%	1%	0%	0%
Cultivation of wheat	9%	3%	5%	7%	1%	5%	5%	7%	6%	5%	10%	4%	4%	3%	2%	0%	5%	11%	4%	6%	15%	2%	5%
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Source: Authors calculation

- Brazilian deforestation embodied in trade, direct and indirect consumption detailed per consumption area. The percentages show the sectors of consumption for each area.

- WM = RoW Middle East
- WA: RoW Asia and Pacific
- WE: RoW Europe
- WF: RoW Africa
- WL: RoW America

3.

Import tariff based on the forest content of traded goods

Counterfactual analysis

Aims

1. To investigate feasible **global policy options** to avoid deforestation without economic damage
2. To address the potential **trade-off** between economic growth and deforestation target

Methodology

- Counterfactual analysis using a Computable General Equilibrium model, the Global Trade Analysis Project (**GTAP**) model, commonly used in ex-ante policy evaluation.
  - ➢We estimate the **level of tariffs** preventing trade on goods embodying deforestation based on the *forest intensity*
  - ➢We evaluate the impact and the **economic cost** for exporting countries (Brazil as case study)

Counterfactual analysis: modelling framework

Forest intensities

- Average incremental deforestation on land use by sector, 2012-2019 from HILDA +
- A split of GTAP agricultural sectors between forestry and no-forestry production
- Setting targets for land use reduction at the sector level

Scenario

- **Domestic tax** on intermediate use of forestry-using products
- **Import tariffs** on forestry use in the production of exported goods: ad valorem equivalents required to meet the target reductions

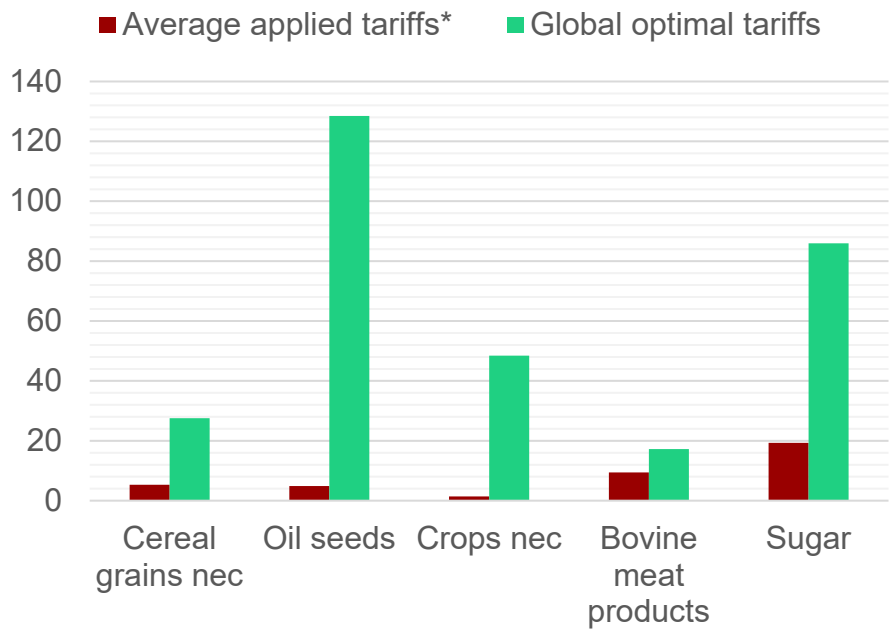
Summary of simulations

	Targeted land reduction (%)	Uniform domestic tax (5%)	Global tariff on forest content
Cereal grains nec	-8.86	x	x
Oil seeds	-14.04	x	x
Sugar cane, sugar beet	-9.98	x	-
Crops nec	-38.27	x	x
Bovine cattle, sheep and goats	-55.5	x	-
Bovine meat products	-	-	x
Sugar	-	-	x

Source: Authors' elaboration.
Note: covered sectors account for the two-third of the total exported agricultural and food value

Preliminary results

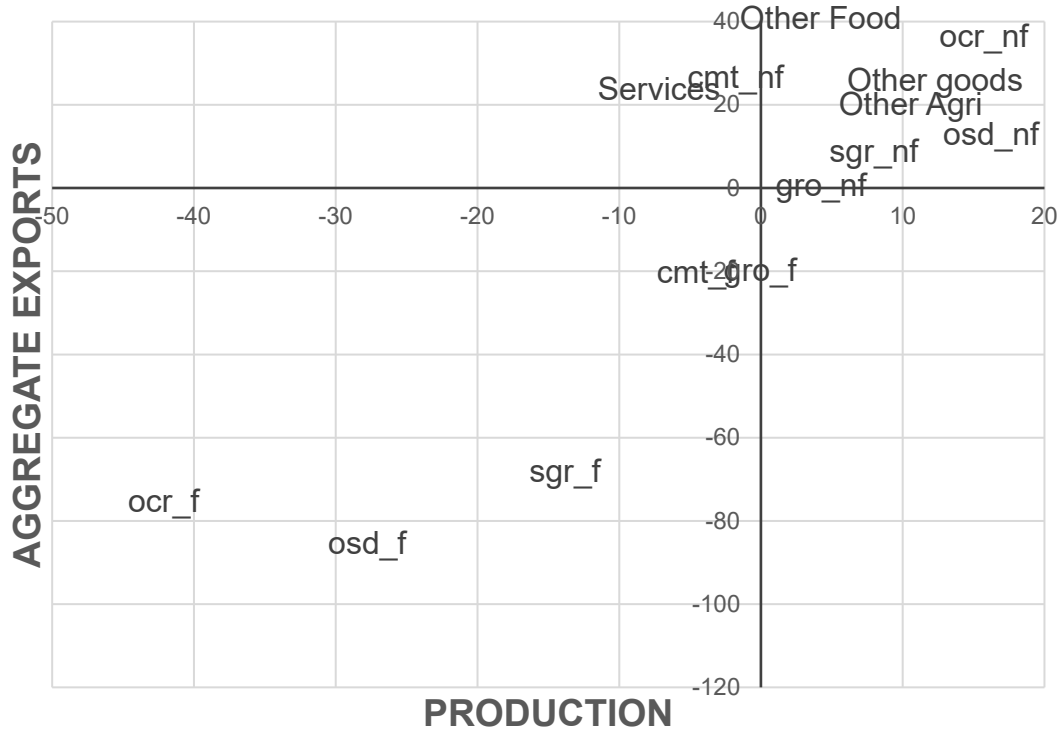
- Tariff rates on imports from Brazil



Source: Authors' simulation using the GTAP model.

Note: Using 'reference group' weights. Data: GTAP DB V11P3, Reference year 2017

- Impact on sector production and trade for Brazil, (% change in volume)



Source: Authors' elaboration using the GTAP model.

**_f: good embodying deforestation *_nf: goods not embodying deforestation*

Preventing deforestation: an economic issue (too)

Preventing trade of goods embodying deforestation could cause **economic "damage"** to specific countries while producing a **global benefit**

Imposing tariffs on Brazilian goods, would harm the GDP of Brazil by around -0.22%

Preventing the loss in the GDP of Brazil would cost around **5 billion of $.**

The capital inflow would prevent the loss by increasing **productivity in no-forest land** by 0.2 percentage point.

Then, Brazilian production would not be affected, i.e. a **win-win scenario**, global environmental benefit with economic neutrality impact.

4.

Conclusion and next steps

Conclusion

- **Trade is an important driver of deforestation in Brazil**. 43% of the Brazilian agricultural deforestation is related to trade with a final consumption located outside of Brazil

- The consumption in China has the most important impact. However, several other countries / areas have significant impacts too (up to two third of the trade related deforestation).

- It is important to take into consideration the indirect trade about this deforestation and more particularly to analyse it precisely at a country level (for instance, 13% at a global level, while 94% for the USA)

- **A trade policy can be a useful instrument**

- It is possible to design a win-win scenario, global environmental benefit (global action to minimize leakage) with economic neutrality impact (addressing root causes of deforestation and promote sustainable production).

Next steps: global focus

- To extend the analysis and cover other relevant countries (Paraguay, Indonesia, Congo)
- To investigate the potential differentiated effect on small vs. large-scale producers
- Cost of certification for no-forestry

Next steps: EU focus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Green Deal: EU agrees law to fight global deforestation and forest degradation drive consumption

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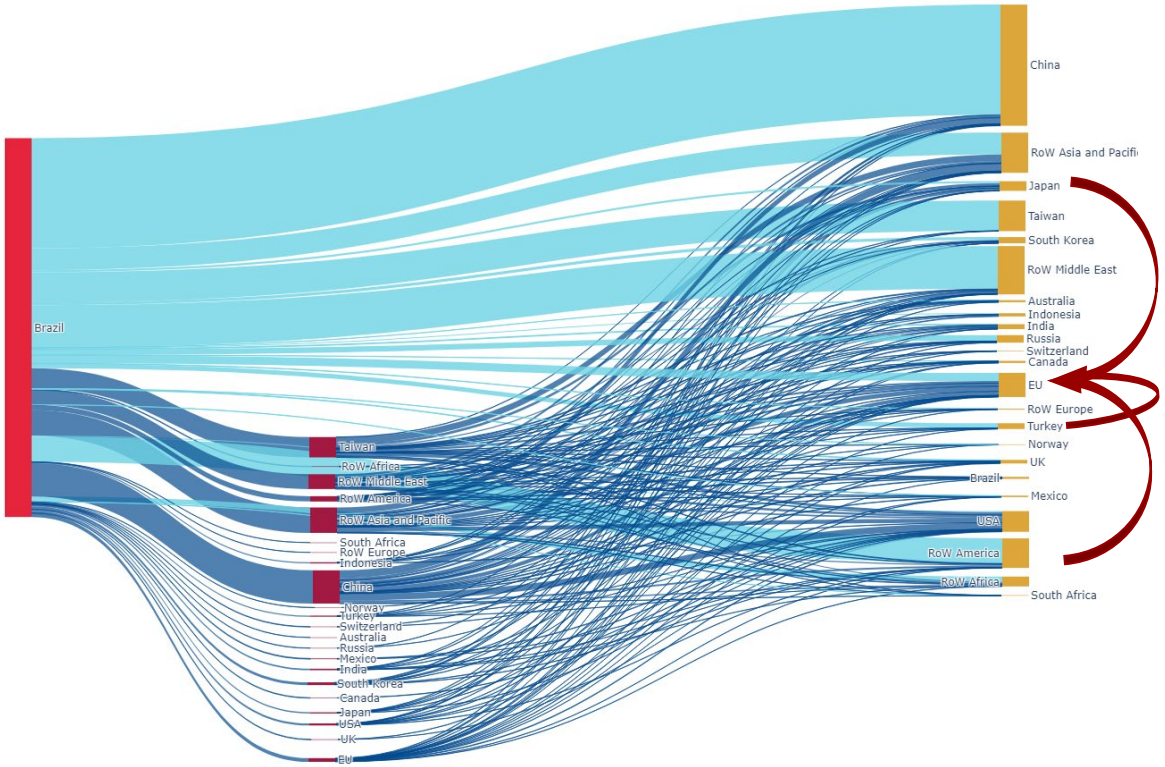
Green Deal: EU agrees law to fight global deforestation and forest degradation driven by EU production and consumption

Brussels, 6 December 2022

The Commission welcomes the provisional political agreement just reached between the European Parliament and the Council on an EU Regulation on deforestation-free supply chains. Once adopted and applied, the new law will ensure that a set of **key goods placed on the EU market will no longer contribute to deforestation and forest degradation in the EU and elsewhere in the world**. Since the EU is a major economy and consumer of these commodities, this step will **help stop a significant share of global deforestation and forest degradation**, in turn reducing greenhouse gas emissions and biodiversity loss. This major agreement comes just before the start of the milestone Conference on Biodiversity (COP15) which is set to define protection goals for nature for decades to come.

When the new rules enter into force, all relevant companies will have **to conduct strict due diligence if they place on the EU market**, or export from it: **palm oil, cattle, soy, coffee, cocoa, timber and rubber as well as derived products** (such as beef, furniture, or chocolate). These commodities have been chosen on the basis of a thorough impact assessment identifying them as the main driver of deforestation due to agricultural expansion.

- To compare the case of EU action and the global tariffs (California effect)
- Using an iterative process to evaluate, based on the supply chain dependences, which country could be associate maximizing the forest protection and minimizing the cost (to strength the EU negotiation strategy)

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