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CREATING LEVERAGE TO ENHANCE BIODIVERSITY OUTCOMES OF GLOBAL BIOMASS TRADE

Assessing the biodiversity footprint of Brazilian soy commodities: a spatially explicit approach

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Global trade and biodiversity loss

- International **trade of agricultural and forest commodities** is responsible for more than half of the **global loss of forests** and natural vegetation every year
- **Losing a forest** means losing **biodiversity,** besides the effect on **climate change**
- **Direct drivers of biodiversity loss** (IPBES 2019): LU-LUC, climate change, pollution, invasive alien species, and the anthropogenic exploitation of wildlife
- Parallel to financial information, **information on the impacts of supply chains** (e.g., carbon and biodiversity footprints) **is crucial**

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CLEVER objectives

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- How international trade in agricultural and forest products drives biodiversity impacts through non-food biomass supply chains (soy, timber)
- What are the main biodiversity loss hotspots in major producing and exporting countries (Africa, South America)
- How to co-design solutions for more sustainable production and consumption of agricultural and forestry commodities

Objective: To quantify the biodiversity footprints of the global market of Brazilian soybean based on spatially explicit LCA

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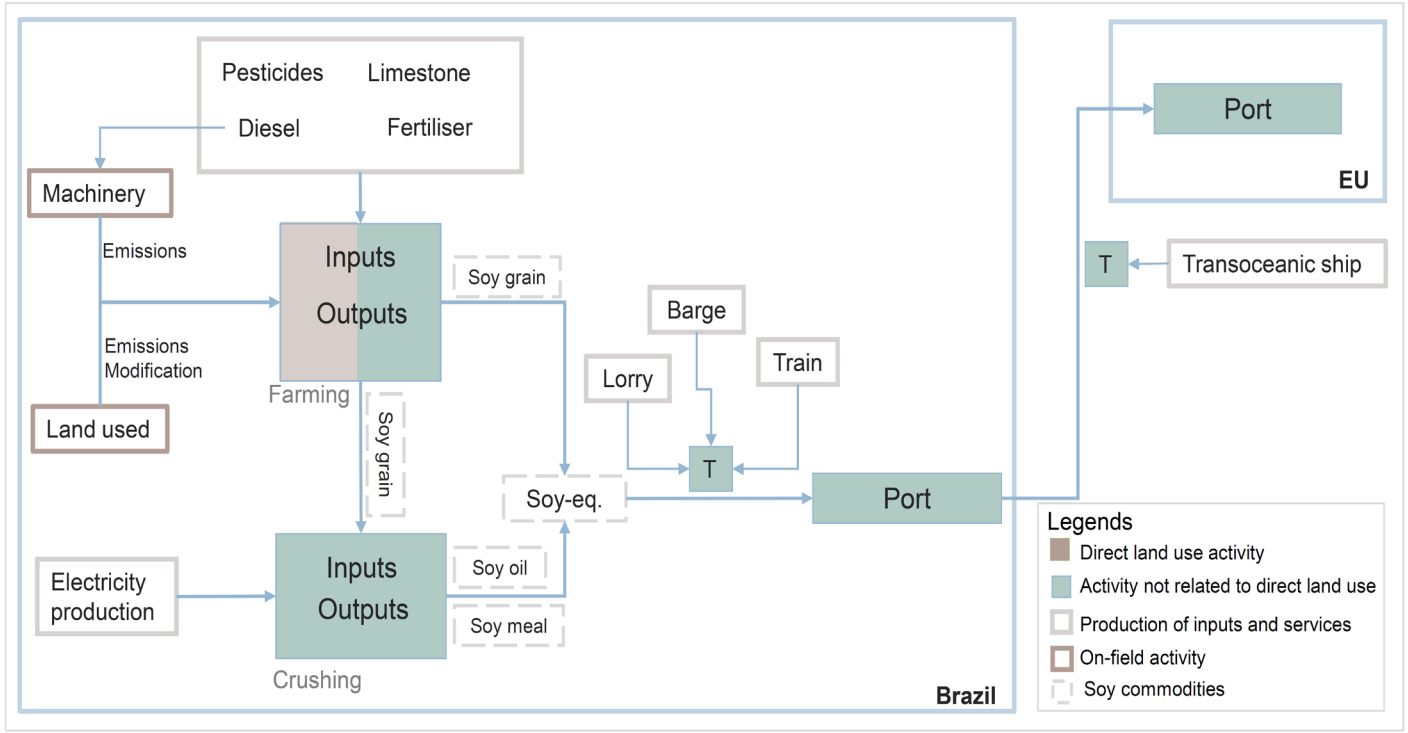
Methods

Spatially explicit LCA for biodiversity loss including land use change and downstream impacts

- Drivers: LU-LUC, climate change, and pollution
- Geographical scope: Brazilian municipalities exporting soy to the EU (Trase database)
- Temporal scope: from 2004 to 2022
- Reference units: 1 t of soy products (grain, oil, and meal) traded yearly and 1 t of soy-eq



System boundaries

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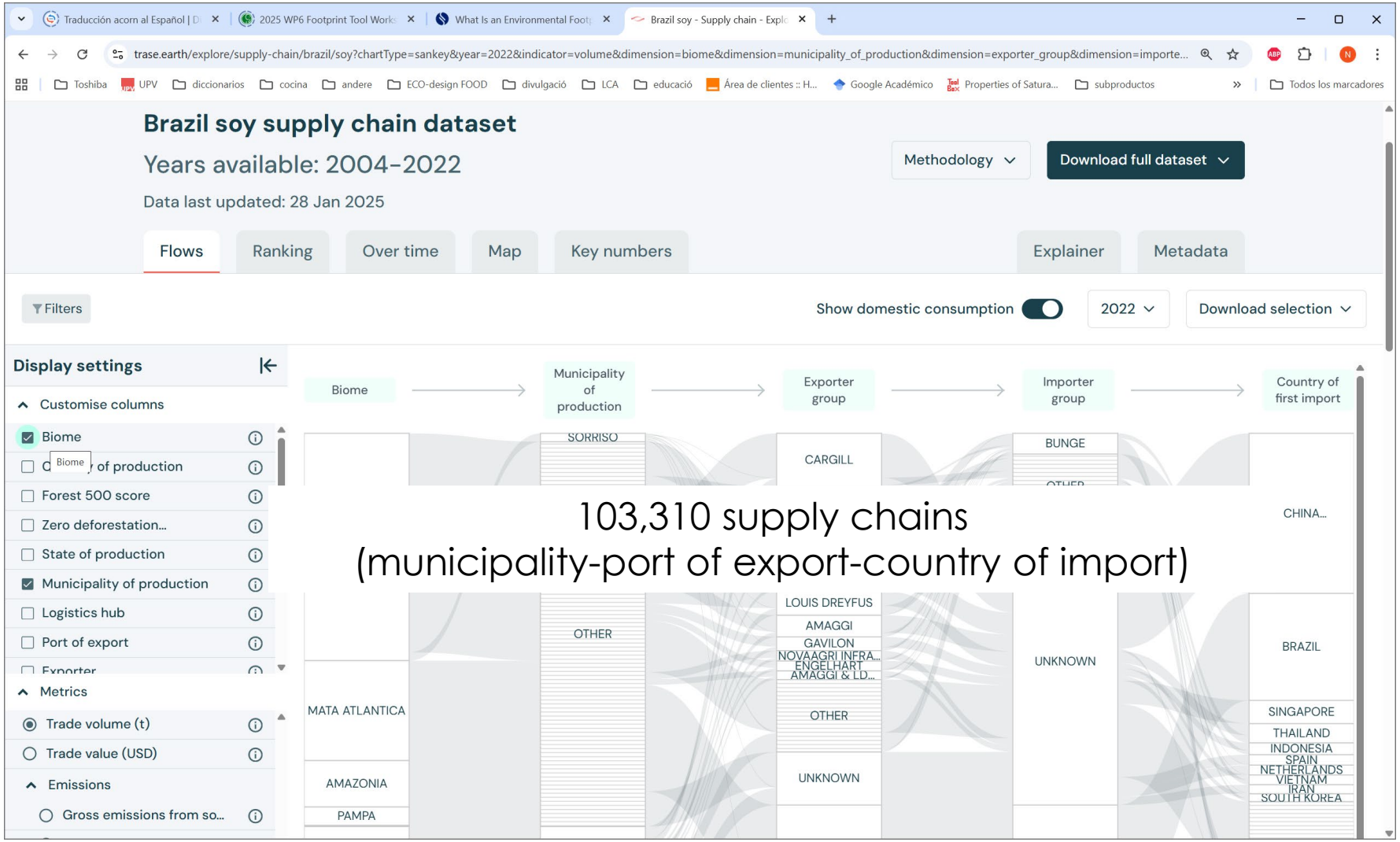
Characterization of the supply chains

https://trase.earth/open-data

Relevant data:
exported soybeans (ton soy eq.), municipality of origin, harvested land areas (ha), origin, destination port, and exporter and importer groups

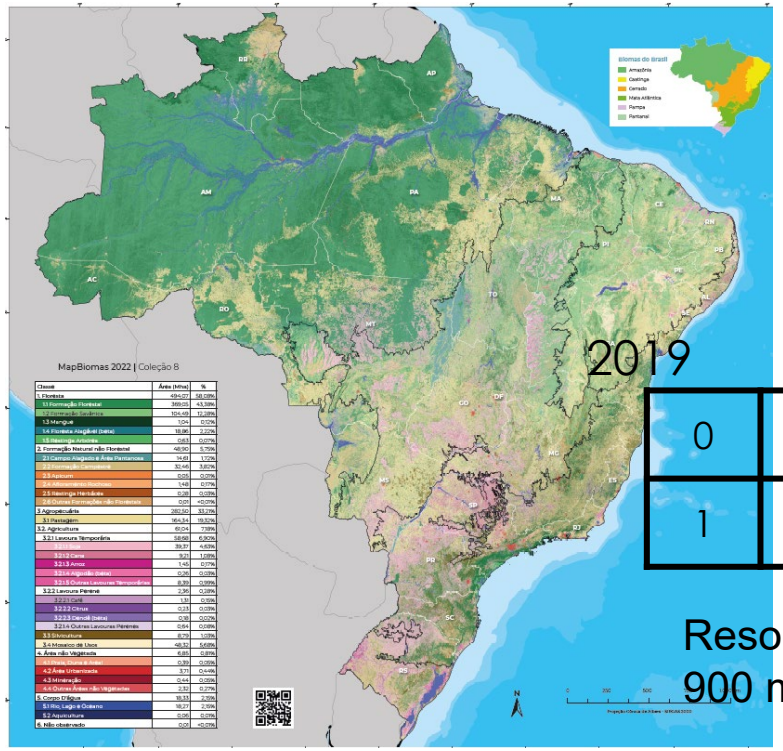


Biodiversity footprint: activity data

Activity data	Type of data	Representativeness	Primary data source
Land use areas	Downloaded	At the municipality level	Trase + Map Biomas
GHG emissions from changes in the carbon stocks	Estimated	A mix between TIER 1 data and Spatially explicit land cover and SOC layer at 30 m of resolution	IPCC (2019,2006) + Mapbiomas
Input consumption in farming	Estimated	At the state or regional level	LCA literature
On-field emissions in farming	Estimated	At the TIER 1 level	IPCC (2019,2006) & (EMEP/EEA, 2019)
Input consumption in crushing	Estimated	At the state or regional level	LCA literature
Domestic transport	Estimated	At the supply chain level	ORS tool in QGIS
International transport	Estimated	At the supply chain level	Least path cost in QGIS

Areas of land transformation and occupation

MAPBIOMAS
BRASIL



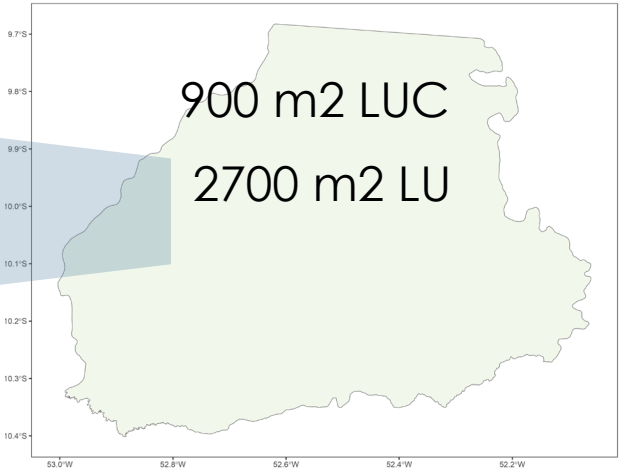
0 = Non-human modified LU
1 = Human modified LU

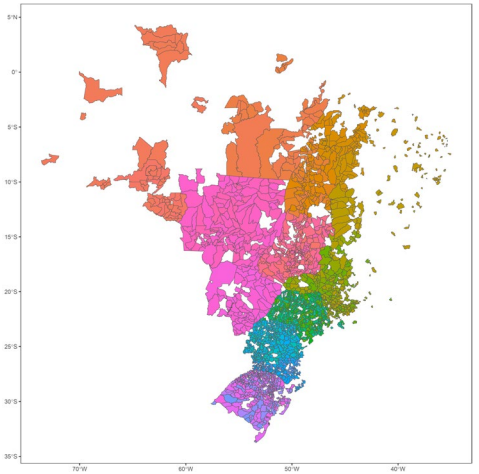
2019

0	1
1	1

2022

1	1
1	1

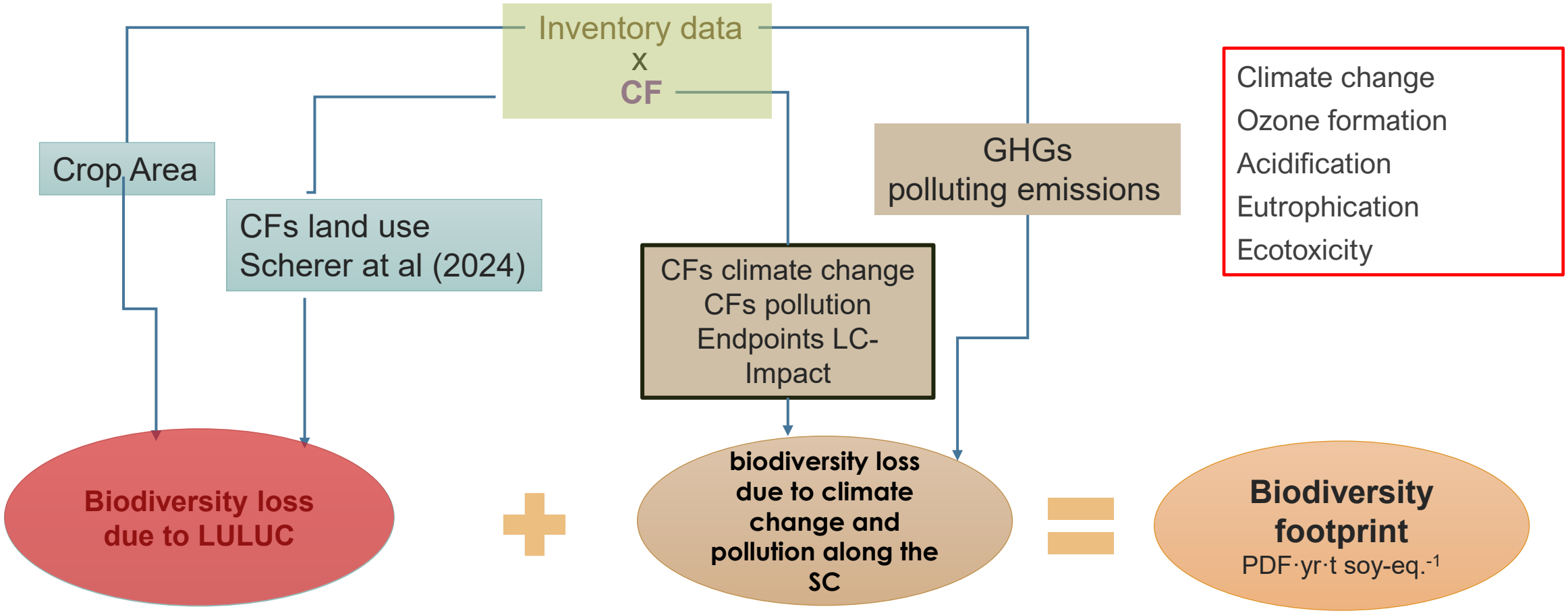




Resolution: 0.3 degrees
900 m^2 in equator

Land uses in 2022 vs. 2019 (t-3)

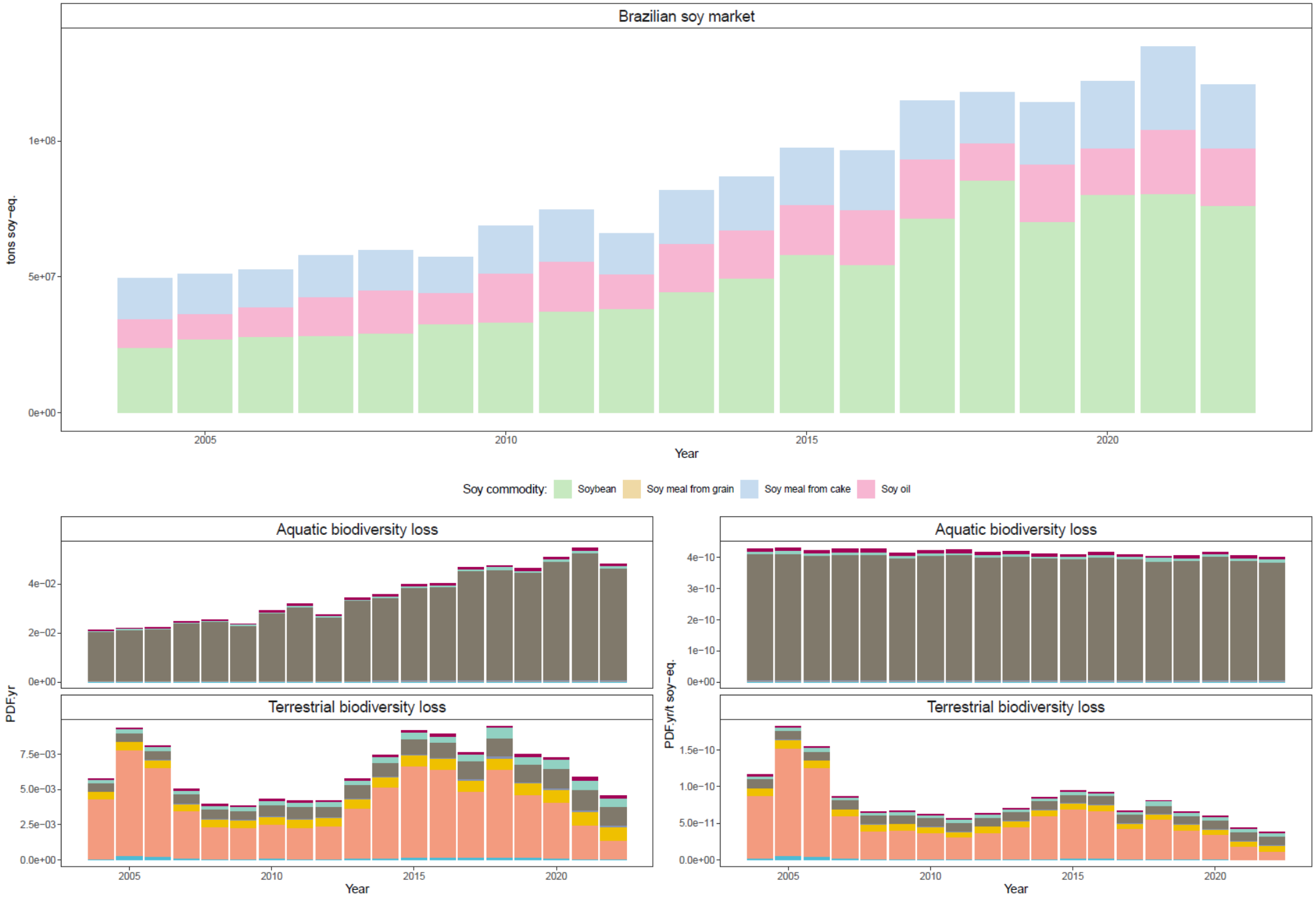
Spatially explicit LCA for biodiversity loss including land use change and downstream impacts

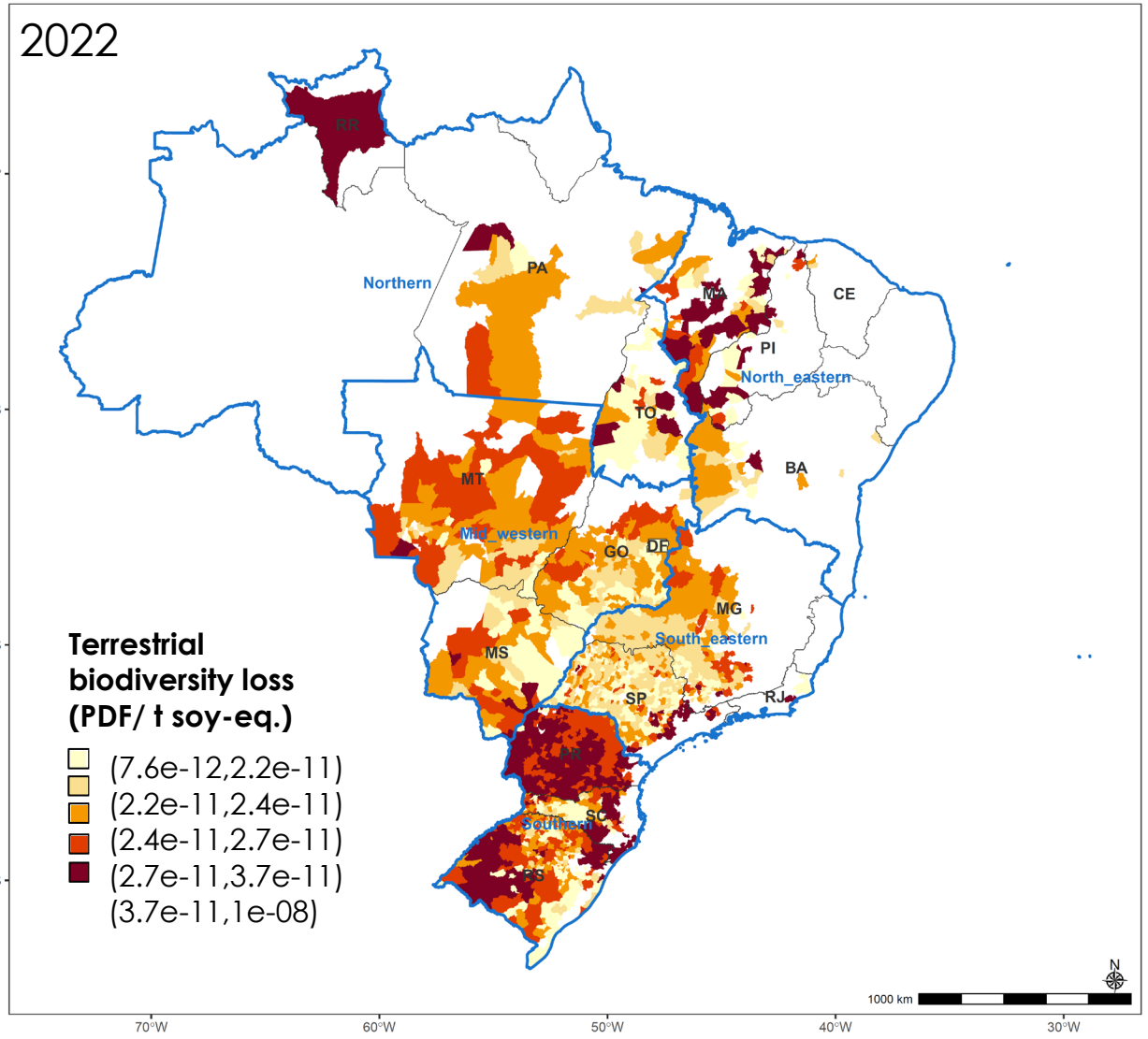


Uncertainty analysis

- Uncertainty of the **characterisation factors to assess land-driven biodiversity loss.**
- Uncertainty of **GHG emissions due to changes in carbon stocks** (e.g., carbon content in above-ground biomass and SOC content).
- Uncertainty of **input consumption in farming and crushing** (quantity of input consumed).
- Uncertainty of the emission factors used to estimate the **farming on-field emissions** (e.g., direct and indirect N_2O from nitrogen fertiliser application).

Results


Brazilian soy market
tons soy−eq.
1e+08
5e+07
0e+00
2005
2010
2015
2020
Year
Soy commodity:
Soybean
Soy meal from grain
Soy meal from cake
Soy oil
Aquatic biodiversity loss
PDF.yr
4e−02
2e−02
0e+00
Terrestrial biodiversity loss
7.5e−03
5.0e−03
2.5e−03
0.0e+00
Aquatic biodiversity loss
PDF.yr/t soy−eq.
4e−10
3e−10
2e−10
1e−10
0e+00
Terrestrial biodiversity loss
1.5e−10
1.0e−10
5.0e−11
0.0e+00
Supply chain drivers:
Land transformation
Land occupation
Net emissions from carbon stock changes
Farming
Crushing
Domestic transport
International transport

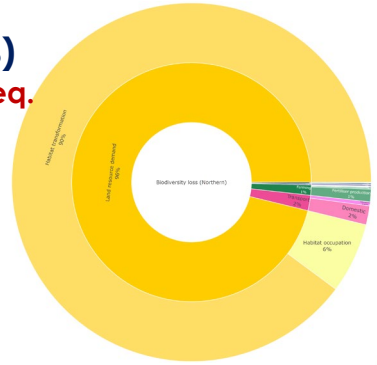


Biodiversity footprint estimated for each supply chain and aggregated at different levels:

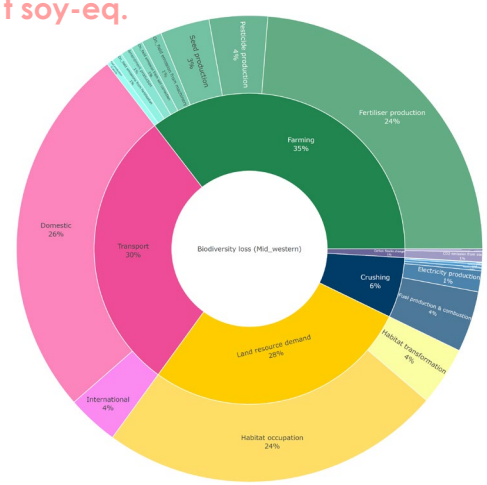
- Producing municipality/state
- Importing country
- Exporting company
- Importing company

Biodiversity footprint: Share of supply chain stages in 2022

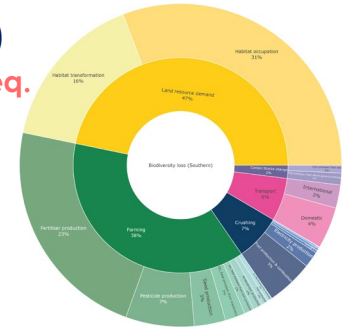
Northern (22.94 %)
2.67 ·10^{-10} PDF · yr/ t soy-eq.

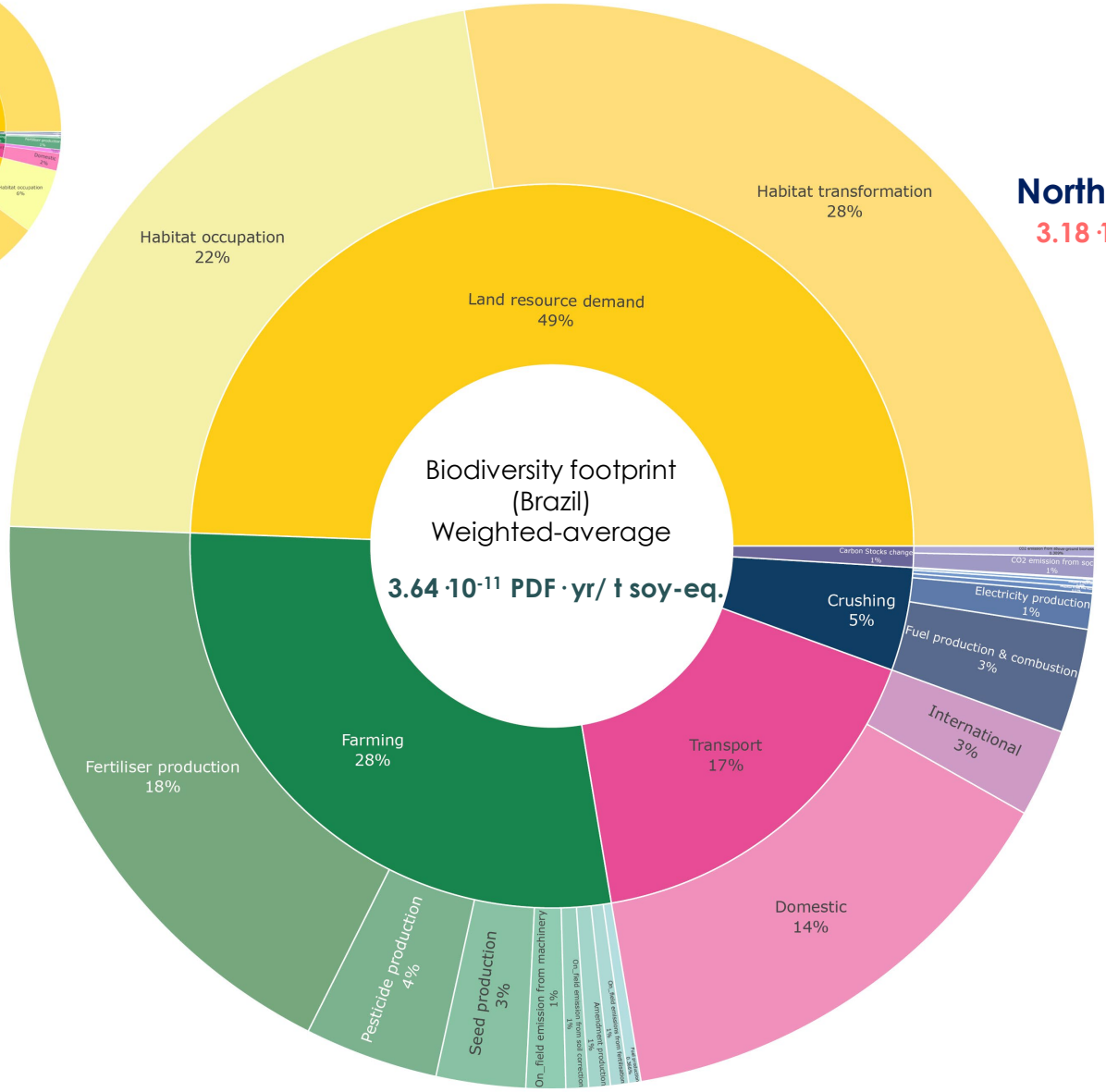


Mid-western (39.86 %)
2.7 ·10^{-11}PDF · yr/ t soy-eq.



Southern (20.85 %)
3.19 ·10^{-11} PDF · yr/ t soy-eq.

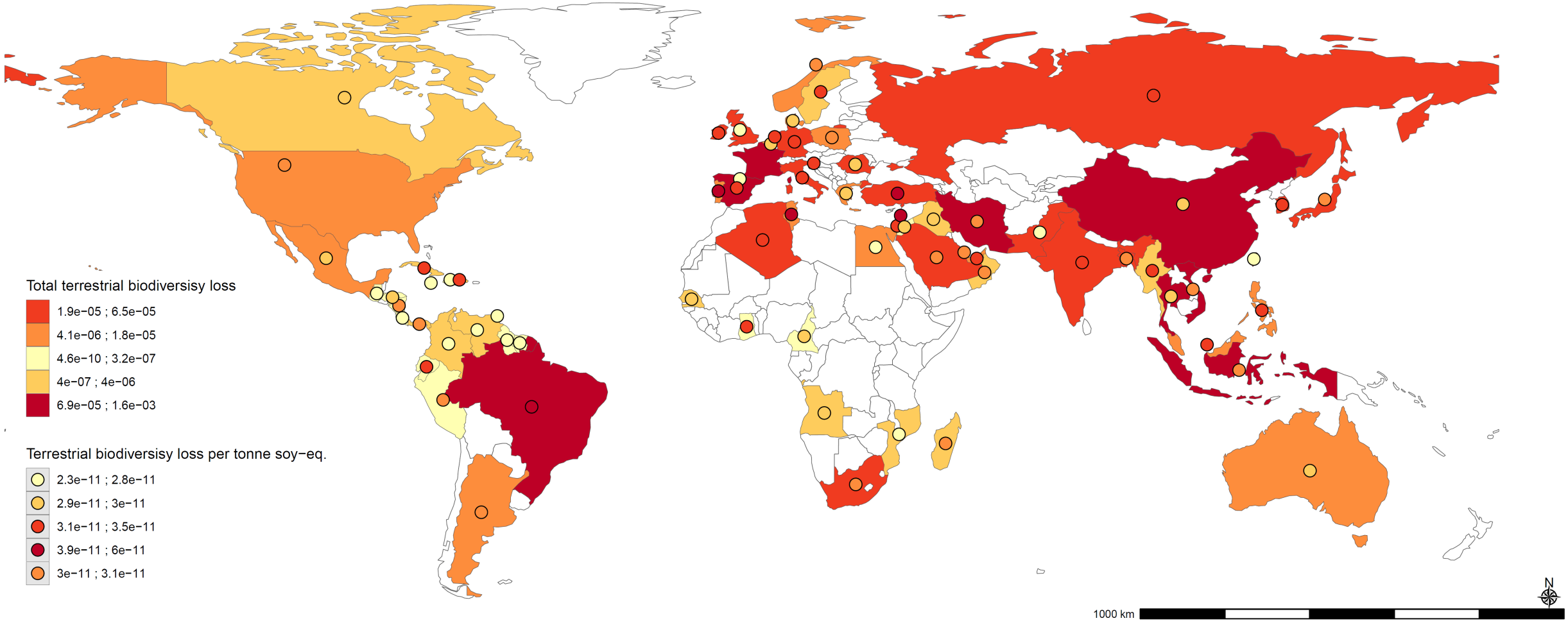




North-eastern (9.51 %)
3.18 ·10^{-11} PDF · yr/ t soy-eq.

South-eastern (6.84 %)
2.52 ·10^{-11} PDF · yr/ t soy-eq.

Biodiversity footprint: destination countries in 2022



Bio_loss Soy-BR|SCH

- Bio_loss Soy-BR|SCH
- Origin Municipality
- First destination country
- Supply chains

Soy commodity

Soy-eq

Environmental Indicator

Terrestrial biodiversity loss

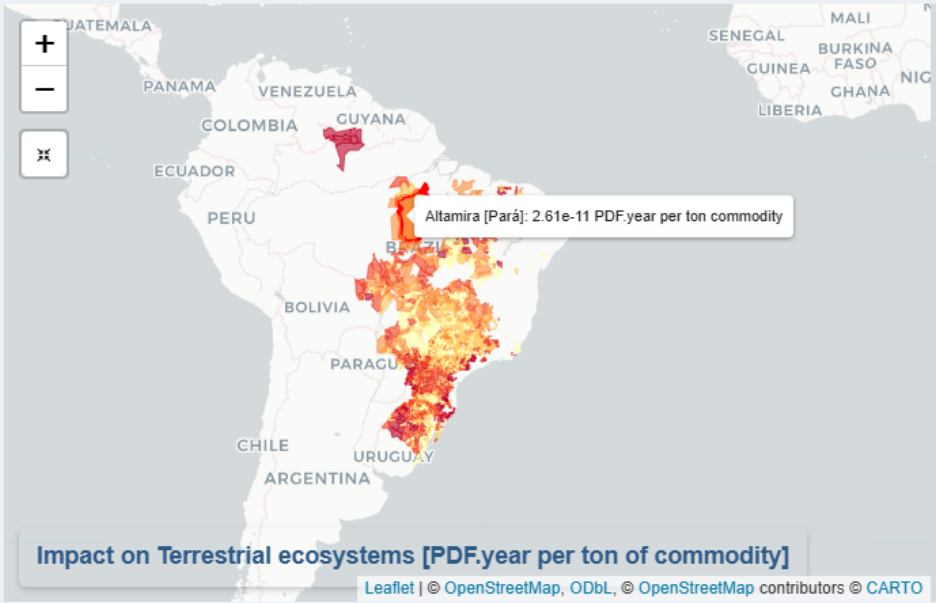
☐ Impact of the total commodity marketed

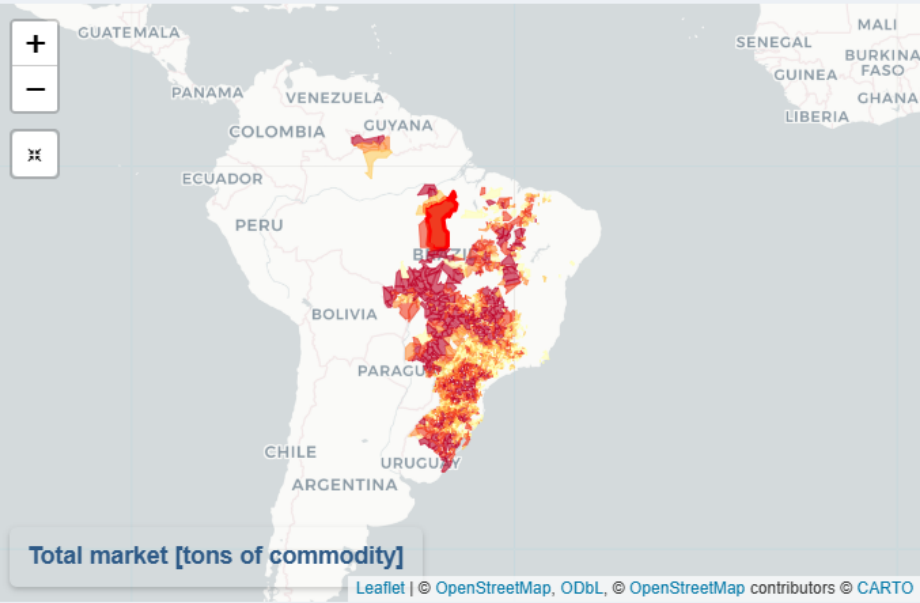
Year

2022

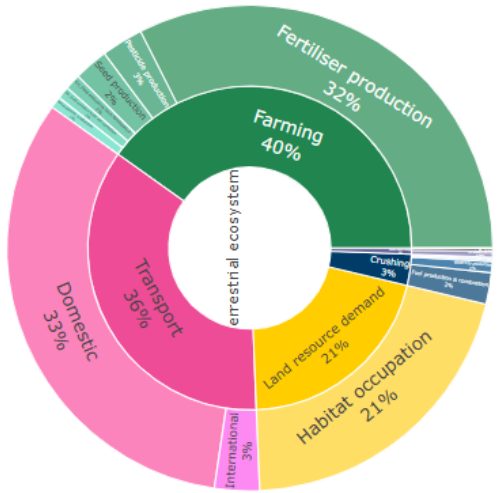
Contribution analysis:

Supply chain stages

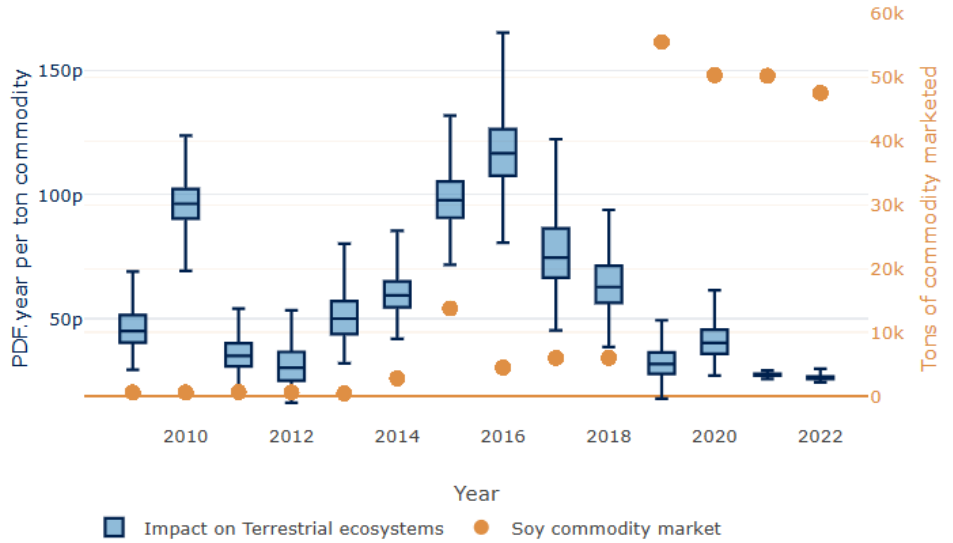




Contribution of the supply chain stages | Pará: Altamira |



Trend of the impact and market [Pará: Altamira]



Conclusions

- Strong concentration of impacts in specific regions together with weak correlations between trade volume and environmental damage, suggests that policies based solely on deforestation metrics or country averages (e.g. EUDR), are unlikely to deliver meaningful biodiversity outcomes and may exacerbate leakage risks).
- By explicitly linking buyers to biodiversity hotspots, our approach aligns with calls for enhanced traceability and transparency as prerequisites for effective interventions.

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Thank you!

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