# Revealing Biodiversity Impacts of Land Use Intensification: A Spatio-Temporally Resolved Global Assessment (2000–2019)

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## MOTIVATION

- Land use is the main driver of global biodiversity loss, yet its full impact remains underestimated in Life Cycle Assessment.
- The use of fertilizers, pesticides and increased water use leads to more yield but also puts additional pressure on biodiversity.
- The impact of land use intensification is not yet globally assessed with spatio-temporally resolved data.
  → Need for a remote sensing-based dataset considering land use intensities (Cabernard et al. 2024, Scherer et al. 2023).

## RESEARCH QUESTIONS:

- Does land use intensification alter biodiversity loss over time?
- Which land use type is most driving?
- Where are hotspots of biodiversity loss?

**AIM**: The aim of this work is to derive a spatio- temporally resolved dataset on land use intensity and calculate land use related biodiversity loss from 2000 to 2019.

## RESULTS & DISCUSSION

- Global potential species loss ($PSL_{glo}$) reached 12 % in 2019 due to land use from cropland, pasture, and plantations, increasing since 2000 (Figure 1) .
- Biodiversity loss hotspots: Amazon, Madagascar, and Indo-Malayan region (Figure 3)
- Intensified agriculture, especially plantations, is putting increasing pressure on biodiversity (Figure 2)
- Land abandonment contributes to biodiversity loss due to land use change (around 15 % in 2019)

### Biodiversity Impact from land use by intensity

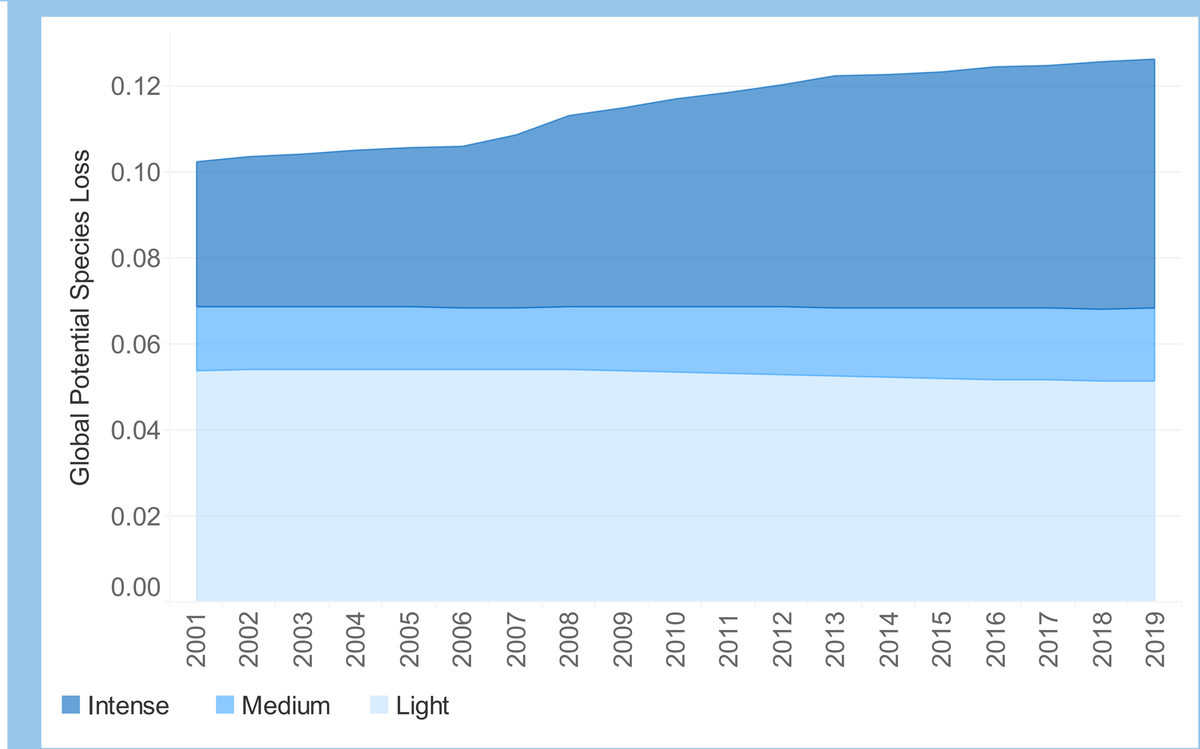



**Figure 1:** Land use impacts on global biodiversity by land use intensity from crops, plantations and pasture land use over time.

### Land use change biodiversity impacts in hotspot regions

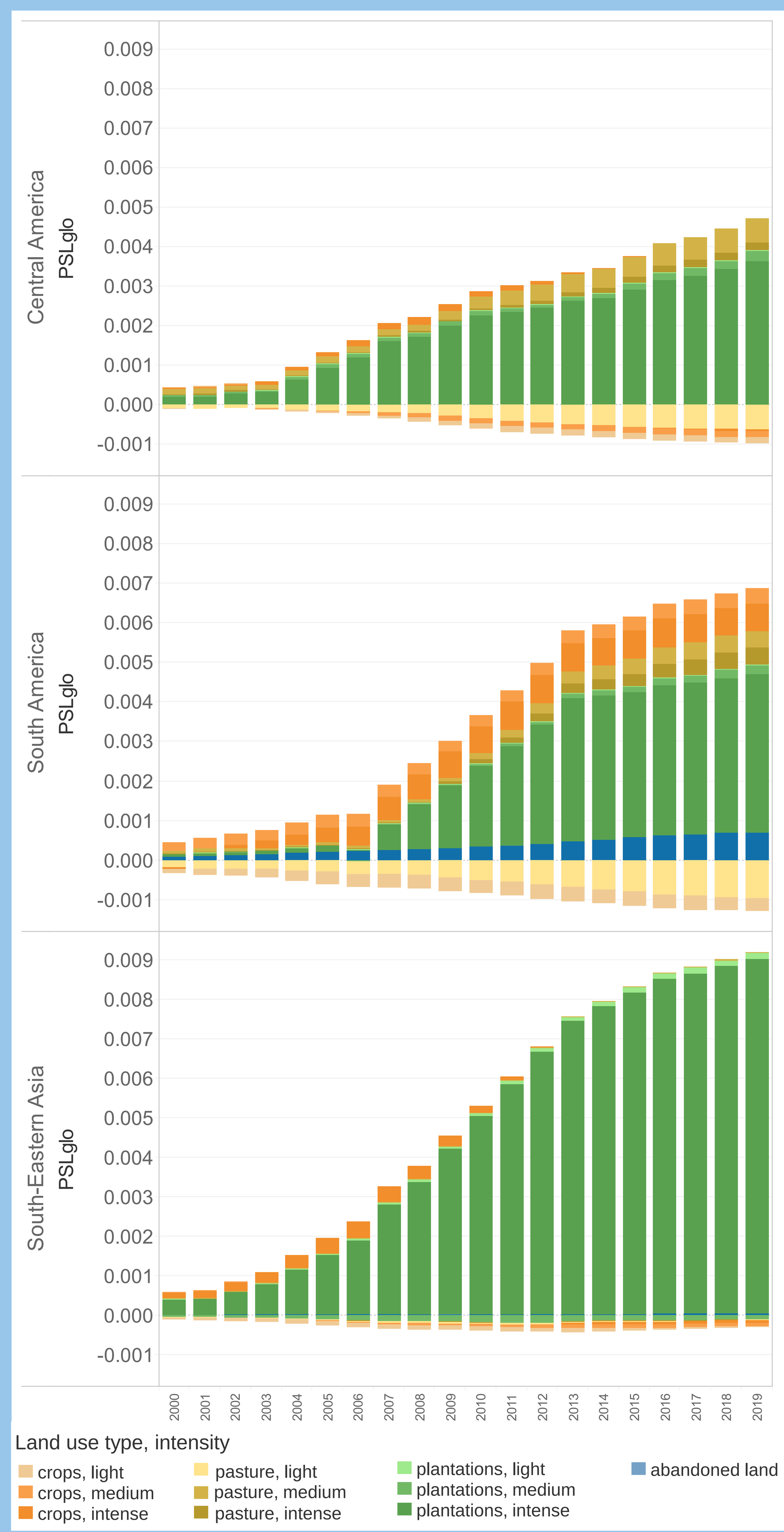



**Figure 3:** Biodiversity Impact from land use in hotspot regions. Units are expressed as global potential species loss ($PSL_{glo}$)

### Biodiversity Impact from land use intensification in 2019

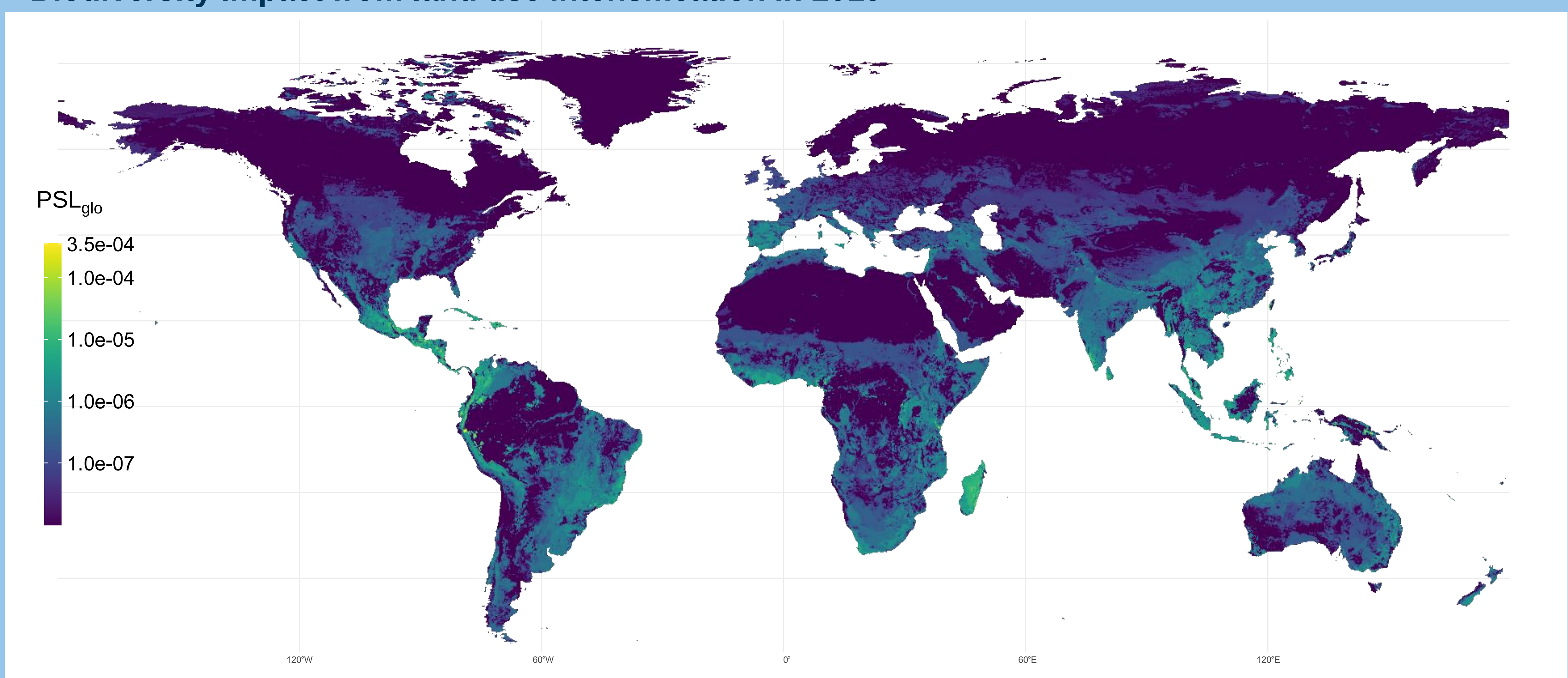
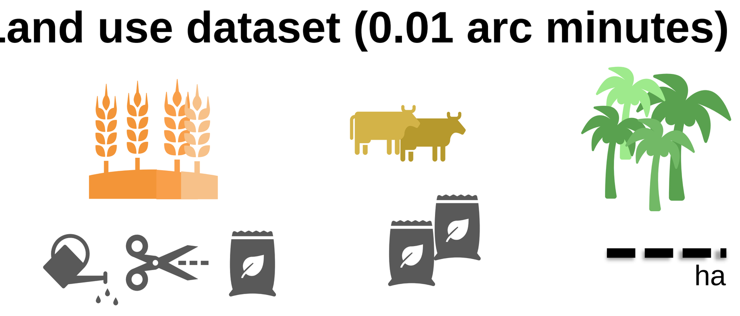



**Figure 2:** Biodiversity Impact of land use intensification (cropland, pastures, plantations) in 2019 expressed as global potential species loss ($PSL_{glo}$) Lighter colors indicate a higher species loss. Biodiversity impacts are especially high in regions with a high number of endemic species.

## METHODS

**Land use dataset (0.01 arc minutes)**




| | | | |
|---|---|---|---|
| Light | Default | N-input < 50kg /ha | Agroforestry |
| Medium | Irrigation or fertilizer use classified as light | N-input 50-150 kg/ha | < 2000 ha |
| Intense | Irrigation, fertilizer use, or harvest intensity classified as intense | N-input >150 kg/ha | > 2000 ha |

**Characterization factors (825 ecoregions)**

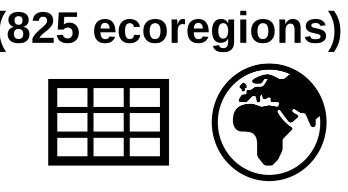
x  = **Global Potential Species Loss**

**Figure 4:** Methodology to derive land use related biodiversity loss. Land use intensities were classified combining different remote sensing datasets (Winkler et al. 2023, Adalibieke et al. 2023, Liu et al. 2021, Mialyk et al. 2024, Tian et al. 2022, Du et al. 2022). Biodiversity loss was calculated multiplying the area of a specific land use type in an ecoregion with the corresponding characterization factor from Scherer et al. 2023. Characterization factors discriminate between 825 ecoregions, five taxa, five land use types, and three Intensity levels.

## CONCLUSIONS AND OUTLOOK

- Land use (change) impacts are spatially variable by several orders of magnitude with acceleration particularly in the Tropics
- Land abandonment drives biodiversity impact of recent land use changes
- Trade analysis can reveal link between biodiversity impact and trade
- Analyze the impact of specific food products (e.g. corn, rice, palm oil) would provide more insights, relevant for mitigation policies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