POLICY BRIEF

THE EU'S IMPORTED BIODIVERSITY LOSS FROM BIOFUELS: CLEANER FEEDSTOCKS, LASTING PRESSURES

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Main messages

- The European Union's (EU) shift away from crops with high indirect land use change (ILUC) and towards advanced biofuels is effective at mitigating the per-unit biodiversity impacts.
- **Rising consumption has partially offset these gains**, limiting the long-term reduction in total biodiversity impacts.
- **Biodiversity impacts occur overwhelmingly abroad**, especially in terms of species richness loss, because of the EU's **reliance on imports**.

Context

The BAMBOO project aims to identify trade-offs between biodiversity impacts along global supply chains of non-food biomass and to determine leverage points for transformative change. Global trade of non-food biomass accelerates biodiversity loss globally, yet the way consumption in one part of the world drives biodiversity loss in another is not traced properly. Biofuels are at the heart of such concerns, as biofuel supply chains are highly globalized and induce massive flows of biomass. In the 2010s, the EU's consumption relied mostly on conventional crops, often imported, such as palm oil fruit, rapeseed, maize and wheat. Through its Renewable Energy Directive (RED), the EU has set ambitious goals regarding its renewable energy consumption, including biofuels, with a target of at least 5.5% of energy supplied to transport to stem from advanced biofuels and renewable fuels of non-biological origin by 2030. It has also capped the share of biofuels from conventional crops at 7%, and planned a complete phase-out of biofuels produced from crops carrying a high ILUC risk. Although the RED is designed to mitigate greenhouse gas (GHG) emissions, it is equally important to look at its impacts on biodiversity and to highlight potential trade-offs and synergies. To assess the biodiversity impacts of biofuel consumption, we developed a physical input-output model for biofuels, FABIO-BCP, capable of tracking non-food biomass flows from agricultural and industrial feedstocks through to finished biofuel products with unprecedented granularity. Three biofuel products were included: biogasoline, biodiesel, and renewable diesel, making up the vast majority of global liquid biofuel production between 2012 and 2022. This policy brief gives an overview of the biodiversity impacts of the EU's biofuel consumption between 2012 and 2022, tracing the impacts back to the feedstocks and quantifying imported biodiversity loss, with spatial and temporal detail.

BIODIVERSITY INDICATORS

We integrated two different biodiversity indicators in our model. First, we calculated the mean species abundance (MSA)-loss•km². This metric multiplies the fraction of species abundance lost by the area over which that loss occurs. Intuitively, this amounts to the ecologically intact area lost. We thus call this metric "pristine area loss equivalents". We used the Intactness-Based Impact Factors (Schipper et al., 2025).

Second, the potentially disappeared fraction (PDF) of species measures the fraction of species that would be driven to global extinction if a certain level of pressure was maintained over a long period. These impact factors were drawn from LC-Impact v2 (see v1 in Verones et al. (2020)).

At the current state of implementation, both indicators have limitations. The MSA-loss•km² is a relative and local abundance loss metric. It is unweighted by actual species abundance, which limits its relevance for spatial comparisons: 1 MSA-loss•km² has different implications for global biodiversity between Indonesia and Poland. Weighting by local abundance would greatly change the relative impacts of feedstocks, especially for palm oil from Indonesia.

The LC-Impact v2 is better suited for spatial comparisons and aggregation, as it is weighted by local species richness. However, different modelling approaches used for different impact categories limit the comparability across impact categories. Because of this and because land use is the dominant driver of terrestrial biodiversity loss, we disaggregated richness loss from land use from the other drivers and reported them separately.

Key results

Biodiversity impacts from EU biofuel consumption mitigated by crucial shifts in feedstock use

Biofuel consumption in 2022 was 29% higher than in 2012. Yet, its estimated **biodiversity impacts** were **20% lower** in terms of mean **species abundance loss**, **2%** in terms of **richness loss** from drivers other than land use and **82%** lower in terms of **land-use-driven richness loss** (Figure 1a). This decreased impact was mostly enabled by a shift away from conventional crops, whose share in EU biofuel supply has consistently declined since 2014.

Palm oil-based biofuel consumption in the EU **peaked in 2018** at 5.5 billion litres and **decreased sharply afterwards to reach only 1 billion by 2022** (Figure 1b). This is a significant development, **as the vast majority of the land-use-driven species richness loss** from EU biofuel consumption was due to **imports of Indonesian palm oil** and palm oil-based biodiesel and renewable diesel. While reduced deforestation for palm oil plantations in Indonesia after 2012 (Austin et al., 2019) already considerably decreased the

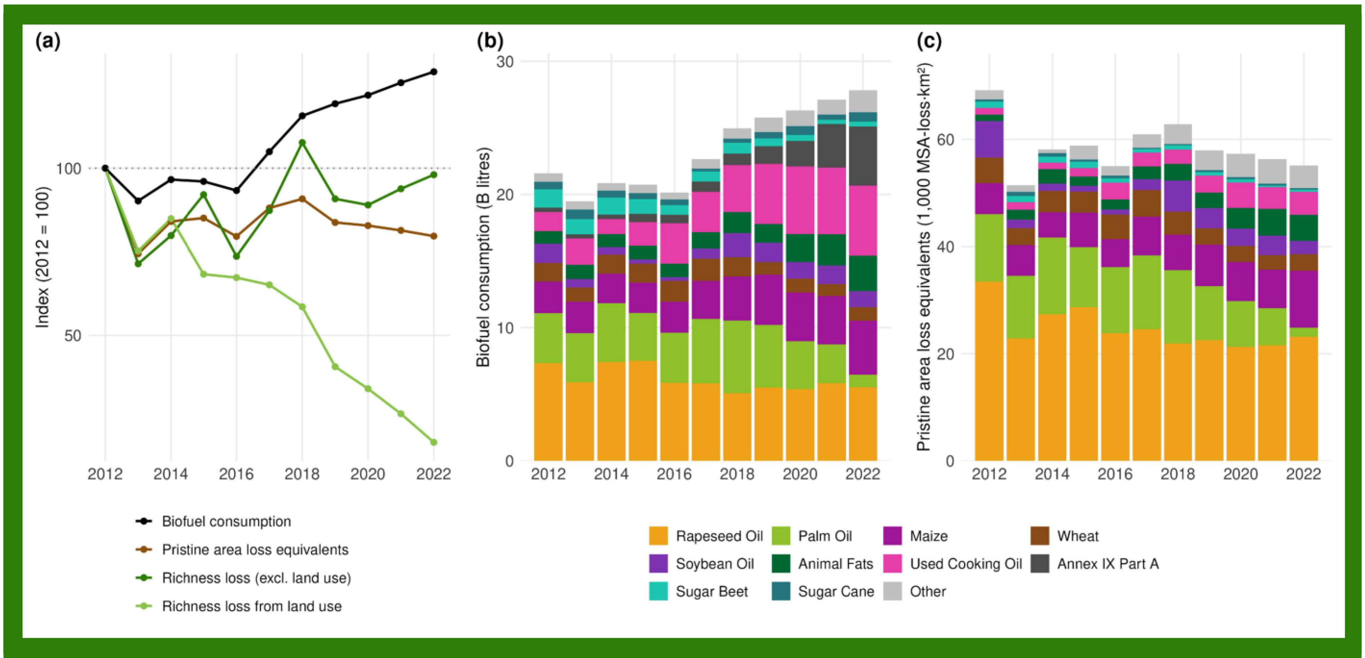

Figure 1: (a) Evolution of EU biofuel consumption and associated biodiversity impacts; (b) Volume of EU biofuel consumption by feedstock type; (c) Biodiversity impacts of EU biofuel consumption by feedstock in Pristine area loss equivalents (2012-2022).

impacts, the palm oil phase-out also contributed to a significant drop in its richness loss footprint from 2019 onwards, and a smaller drop in pristine area loss.

The use of feedstocks eligible for qualification as advanced biofuels (those listed in the RED's Annex IX part A) has increased way more slowly than used cooking oil and waste animal fats (Annex IX part B). By 2022, **used cooking oil** had become the single most important feedstock in the EU's biofuel consumption, overtaking rapeseed oil. Yet, **its total biodiversity impacts remained much lower than those of rapeseed oil and maize** (Figure 1c), highlighting how a shift towards waste feedstocks can mitigate the impact of biofuels.

Imported biofuels and feedstocks inevitably involve imported biodiversity loss

When it comes to biofuel consumption, the EU is by far the most import-dependent region. It imports significant volumes of feedstocks for its own production, and of biofuels produced abroad. The EU's biofuel consumption thus embodies large biomass inflows and imported biodiversity loss, making up approximately half of its total impacts in terms of pristine area loss. Between 2012 and 2014, **the EU consumption was responsible for 27% of total pristine area loss caused by biofuel consumption in Asia (*ASI*), 47% in non-EU European countries (*EUR*), 69% in Oceania (*OCE*),** and under 10% in other regions (Figure 2). By 2020-2022, **most of the positive effects from mitigating the EU's biodiversity impact had occurred in Asia**, dropping to 9% of its total pristine area loss. This was mainly driven by the planned phase-out of palm oil and the decline in its deforestation impact. The contribution of EU consumption in other regions remained similar, and little impact has been relocated to the EU. These results highlight that **the shift towards waste feedstocks has not prevented import dependency and the associated displacement of biodiversity impacts abroad.** Used cooking oil and animal fats are mainly imported from China and the United States, respectively. Indonesia has started exporting large amounts of palm oil mill effluent instead of palm oil.

Limited traceability as a hurdle to sustainable biofuel supply chains

Imports of used cooking oil and palm oil mill effluent have raised concerns about potential fraud, including mislabelling of vegetable oils (European Commission, 2025; Transport & Environment, 2024, 2025). **Waste feedstocks have an inherently limited availability**, and growing demand for them creates incentives for **fraud**. **Importing these feedstocks from distant countries** subject to different regulatory frameworks drives pressures abroad and **limits supply chain traceability and transparency**, which further increases the risk of fraud. Fraud, in turn, might lead to underestimating the volume of conventional crops embodied in EU consumption, as well as their associated impacts. Bioethanol feedstocks typically undergo little to no processing. This concern is most acute in the biodiesel and renewable diesel supply chains, since their feedstocks are already processed by the time they enter the chain.

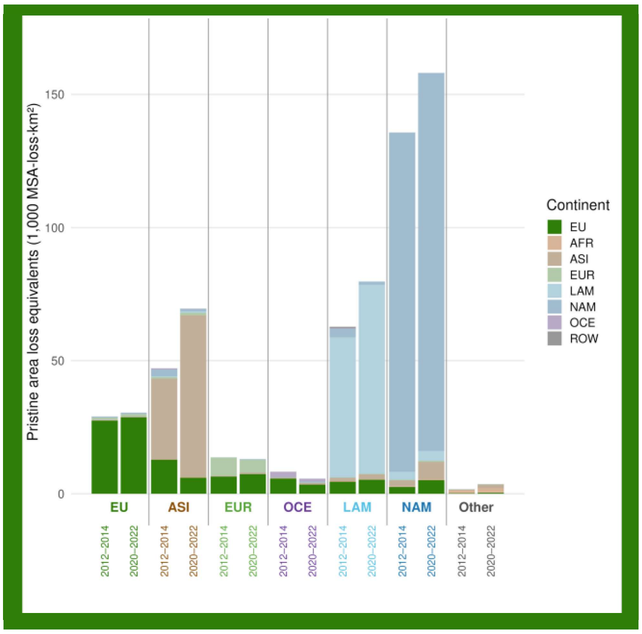

Figure 2: Share of the impact of the EU consumption in regional biodiversity loss driven by biofuels, averaged over years 2012-2014 and 2020-2022.

Recommendations

The EU's **ambitious targets for advanced biofuels** seem as relevant from the perspective of biodiversity impacts as they are for reducing GHG emissions, as the increasing use of waste feedstocks has helped reduce the per-unit biodiversity impacts of biofuel consumption. However, the availability of waste feedstocks is limited, especially domestically in the EU. If the EU aimed to reduce its biodiversity footprint, it would be advisable to encourage domestic production of advanced biofuels. This would require **increasing the domestic supply capacity of waste feedstocks** by promoting the **development of agricultural and industrial waste collection streams**, which have considerable potential for development (Hamelin et al., 2019). EU biofuel producers could also be encouraged to produce advanced biofuels by **promoting knowledge and technology transfer** to plants located in the EU, as capital costs can be high (Sarker et al., 2025).

Furthermore, given the limited potential for development of domestic supply of waste feedstocks, the EU is expected to keep importing some of the biomass required to fulfil its advanced biofuels targets. **Enhancing the traceability of imported feedstocks labelled as waste** will be crucial to prevent fraud from happening, as such fraud invisibly increases the volumes of conventional crops embodied in the EU biofuel consumption. This might involve moving away from the reliance on voluntary certification schemes. The EU could adopt a policy similar to the Deforestation Regulation (2023), demanding **due diligence statements from the operators supplying waste feedstocks.** Just like the Deforestation Regulation does for high deforestation risk commodities, implementation cost could be limited by **targeting a set of commodities that are subject to fraud**, starting with used cooking oil and palm oil mill effluent.

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