POLICY BRIEF

BALANCING BIODIVERSITY RISKS, BIOMASS SUPPLY, AND FOOD SECURITY IN 2050

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August 2026

Main messages

- **No single measure is effective everywhere.** Cutting demand is most effective in wealthier regions that over-consume, while protecting land, raising productivity, and cutting emissions are most important in low-income tropical regions with large yield gaps.
- **Protecting nature can raise food prices.** This trade-off is concentrated in tropical and low-income regions, where the most effective measures for biodiversity either limit food supply or intensify competition for land, and even combined, they leave Eastern and Western Africa with continued biodiversity decline and high food prices.
- **Impacts and responsibilities cross borders.** Because regions trade biomass, protecting nature in one region can displace pressure onto another, so lasting progress requires shared sustainability standards, supply-chain responsibility and social protection that follow traded biomass across borders.

Context

The BAMBOO project builds models and tools that show how global production, trade and consumption of non-food biomass affect biodiversity. Biomass for energy and materials is expanding to help meet climate targets, yet it competes with food for the same land and water, linking its growth directly to diets, food prices and biodiversity. Unsustainable production can deepen habitat loss, water stress, soil degradation, and species decline.

Nature and climate goals are set through separate frameworks, from the Kunming-Montreal Global Biodiversity Framework and the EU Biodiversity Strategy for 2030 to the Paris Agreement and the EU Renewable Energy Directive, yet they all compete for scarce land resources. Decision-makers still lack regional evidence on how different conservation and climate measures affect biodiversity, food prices, and import dependence together.

This brief helps close that regional gap in two steps. First, integrated assessment modelling tests three interventions, namely cutting demand, protecting land, and cutting emissions, and tracks how each changes biodiversity, food prices, and import dependence in every region by 2050 relative to 2020. Second, a stakeholder workshop with policymakers, researchers and practitioners from European and international institutions translated those results into concrete policy instruments and identified the barriers and enabling conditions that determine their effectiveness. A companion BAMBOO policy brief sets out the global and EU-level projections and their implications under current policy settings (Bos et al., 2026).

Key results

- **Protecting land** shields 50% of land from conversion.
- **Cutting demand** shifts diets worldwide towards a healthy, less meat-intensive pattern (EAT-Lancet) by 2050 and reduces food waste and material and energy use to maximum technical potentials.
- **Cutting emissions** holds warming well below 2 °C through carbon pricing, with biomass energy use limited to 100 EJ.

On a scale where 1.0 represents undisturbed nature, the biodiversity model tracks how intact wildlife communities remain under three main human pressures, namely land use, climate change, and nitrogen deposition. Mean species abundance (MSA) is used as the indicator.

For each region, we assessed three outcomes jointly, namely the change in biodiversity from 2020 to 2050, food prices as a signal of social risk, and reliance on imports as a signal of economic vulnerability (Figure 1).

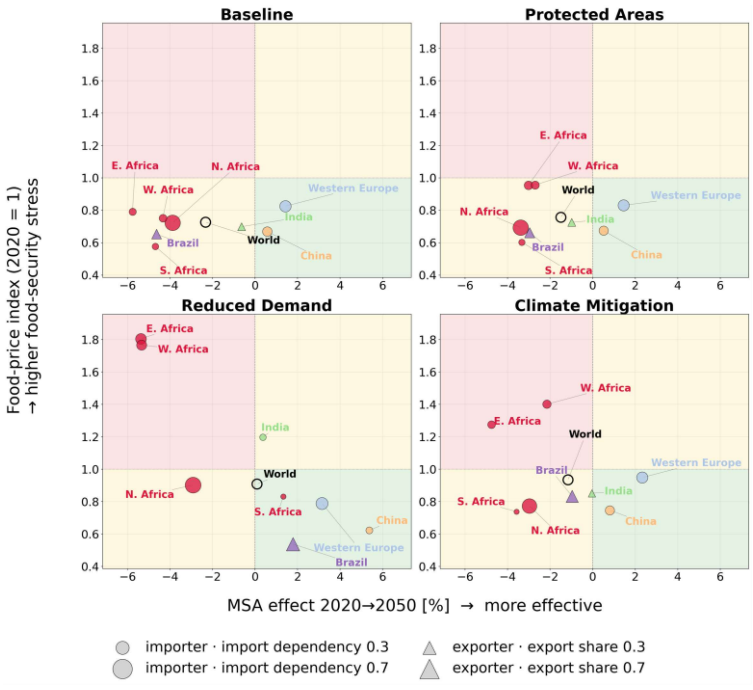
Globally, cutting demand is the most effective single measure for biodiversity, and on average achieves this without raising food prices, while cutting emissions contributes most to limiting warming. At the regional level, however, outcomes diverge sharply.

In Western Europe, a wealthy importer, cutting demand is most effective at almost no cost to food prices, because lower livestock consumption frees domestic pasture. Protecting land has little effect, as the model projects almost no agricultural expansion in the region.

In China, cutting demand is again most effective and, by lowering demand for domestically grown crops, also reduces reliance on imports.

In India, where demand is still growing, cutting demand yields the largest biodiversity gain but raises food prices, because a healthier diet reduces little over-consumption in this region, while weaker pressure to raise yields tightens supply and increases imports (see the counterintuitive result below). Cutting emissions is the more balanced option, protecting biodiversity through higher yields without raising prices.

In Africa, a region of rising demand and persistent imports, no single measure prevents biodiversity decline by 2050, except cutting demand in Southern Africa. Eastern and Western Africa have little over-consumption to reduce, so protecting land and cutting emissions are more effective, yet both can raise food prices, as food production, reforestation and bioenergy compete for the same land.



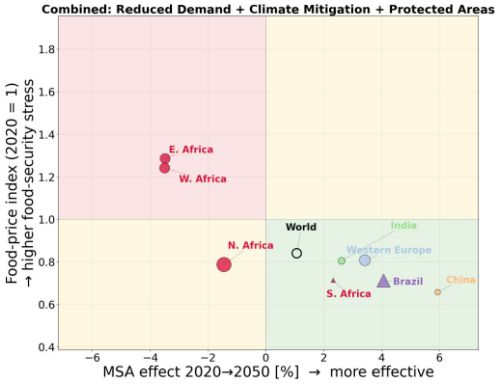


Figure 1: Each region is shown in three dimensions for the baseline and fours alternative scenarios. The horizontal axis shows the change in mean species abundance (MSA) from 2020 to 2050. The vertical axis shows food prices in 2050. The green quadrant is the win-win outcome, meaning biodiversity gains combined with lower food prices.

In Brazil, a tropical exporter, cutting demand is most effective to 2050, because domestic demand drops sharply and demand abroad also weakens, which eases the pressure to clear land for pasture and export crops. By 2100, however, cutting emissions becomes the most effective measure, as climate change becomes the dominant driver of biodiversity loss across the tropics.

Combining all measures delivers both higher biodiversity and lower food prices in most regions, and lifts global biodiversity above its 2020 level by 2050 (Figure 1). Eastern, Western and Northern Africa remain the exception. Biodiversity continues to fall in these regions, and in Eastern and Western Africa, food prices remain high even under the combined measures.

One counterintuitive result deserves attention. In the model, cutting demand also eases the pressure and economic incentives to improve farming, so low-income regions benefit less from shared innovation and can face higher food prices despite lower demand. This indicates the important role of technology development and transfer, as well as international cooperation that markets alone cannot provide.

The design of emissions cuts matters. Because bioenergy and tree planting compete for land, climate policies that rely heavily on land-based carbon removal can themselves raise food prices and increase pressure on biodiversity, as the African results show. Limiting that reliance, for example by capping land-based bioenergy, eases the trade-off, whereas demand-side measures benefit biodiversity and lower emissions without competing for land.

Robustness and uncertainty. The region- and time-specific pattern is rational across scenarios, and the food-price trade-off is persistent in tropical and low-income regions. The precise magnitudes are less certain. Our biodiversity measure captures terrestrial species only, and the model probably understates how climate change harms crop yields and land disturbances, which would strengthen, not weaken, the case for cutting emissions. We also represent land protection simply, as preventing conversion in key biodiversity areas, without distinguishing the full range of protected-area types and goals.

Recommendations

1. **Tailor the policy mix to each region and revisit it over time.**

A single global template risks being ineffective or even harmful. Demand-side instruments suit wealthier regions that over-consume, including the public sector leading by example, food-waste regulation, circular-economy and material-efficiency measures that ease pressure on natural resources, taxes on high-footprint products, and consumer information that links diet to health. In low-income tropical regions with yield gaps, protecting land and raising farm productivity are more effective, through agroforestry that combines biomass production and biodiversity, corridors that connect habitats, payments for ecosystem services, and support for smallholders. As climate change becomes the dominant tropical pressure over longer horizons, cutting emissions should carry growing weight there, supported by enforceable targets to retain carbon-rich, biodiverse habitats.

2. **Pair environmental measures with social protection and technology.**

These interventions can raise food prices where they are least affordable. We call for targeted subsidies and social protection, trade-resilience measures such as diversifying trade partners, fair remuneration for farmers, and cooperation on farm productivity and technology transfer, guided by a 'costs-by-cause' principle in which higher-income regions help finance mitigation. In Africa, where several pressures combine, preventing hunger is the priority, with smallholders and shorter rural-to-urban supply chains at the centre.

3. **Harmonise sustainability standards and strengthen supply-chain responsibility, so impacts do not simply move abroad.**

Because biomass is traded, protecting one region can displace pressure onto another. Instruments include shared sustainability standards and traceability building on the Renewable Energy Directive, supply-chain due diligence and the EU Digital Product Passport, safeguards against false

green claims, trade agreements that embed sustainability and protected-area provisions, channelling fines from illegal biomass and wildlife trade back into conservation, and coordinated cross-border conservation and restoration. Coordinated action also reduces the political risk of acting alone, which makes ambitious national measures more feasible.

Barriers and enabling conditions. The main barrier is usually short-term decision-making, not a lack of knowledge, compounded by rebound effects, weak enforcement and corruption, financing gaps, and lost income for landowners when land is protected. Several enabling conditions can help. These include transparent biodiversity baselines with shared data and monitoring, financial instruments that reward nature-based over purely technical solutions such as payments for ecosystem services and emerging nature-credit schemes that also compensate landowners, business assessment of nature-related risk in supply chains, and communication that frames reduced consumption around wellbeing and health rather than restriction.

Cross-cutting principles. Three principles run through the discussion. First, involve local communities and combine scientific with local and indigenous knowledge, so solutions are developed from the bottom up rather than imposed. Second, apply systems thinking to target the highest-leverage points and to encourage positive tipping points rather than incremental change. Third, because biomass, biodiversity, water, health and climate are interlinked, assess new policies against all of these together, as the IPBES Nexus Assessment (IPBES, 2024) sets out, which reveals synergies, avoids shifting problems from one domain to another, and helps mobilise action beyond environment ministries.

Acknowledgements

We thank all participants of the BAMBOO scenario stakeholder workshop (July 2026) for their contributions, including Freya Laing (Joint Nature Conservation Committee, UK), Andrea Hagyo (European Commission Joint Research Centre), Leena Kopperoinen (Finnish Environment Institute), Susie Turpie (Scottish Government), Jure Čuš (European Commission, DG AGRI), Lucie Vidonne (European Commission), Leslie Prosy (Critical Insights in Environmental Science and Technology), Dominique Vandekerchove (Sciensano, Belgian Biodiversity Platform), Rebecca Kandut (independent consultant), and other anonymous participants

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Co-funded by the European Union

Co-funded by the European Union and the Swiss Confederation. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Swiss Confederation. Neither the European Union nor the granting authority or the Swiss Confederation can be held responsible for them.

Project funded by

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