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Aligning Competitiveness and Sustainability:

How Border Adjustments Can Strengthen the EU's Agricultural Policy

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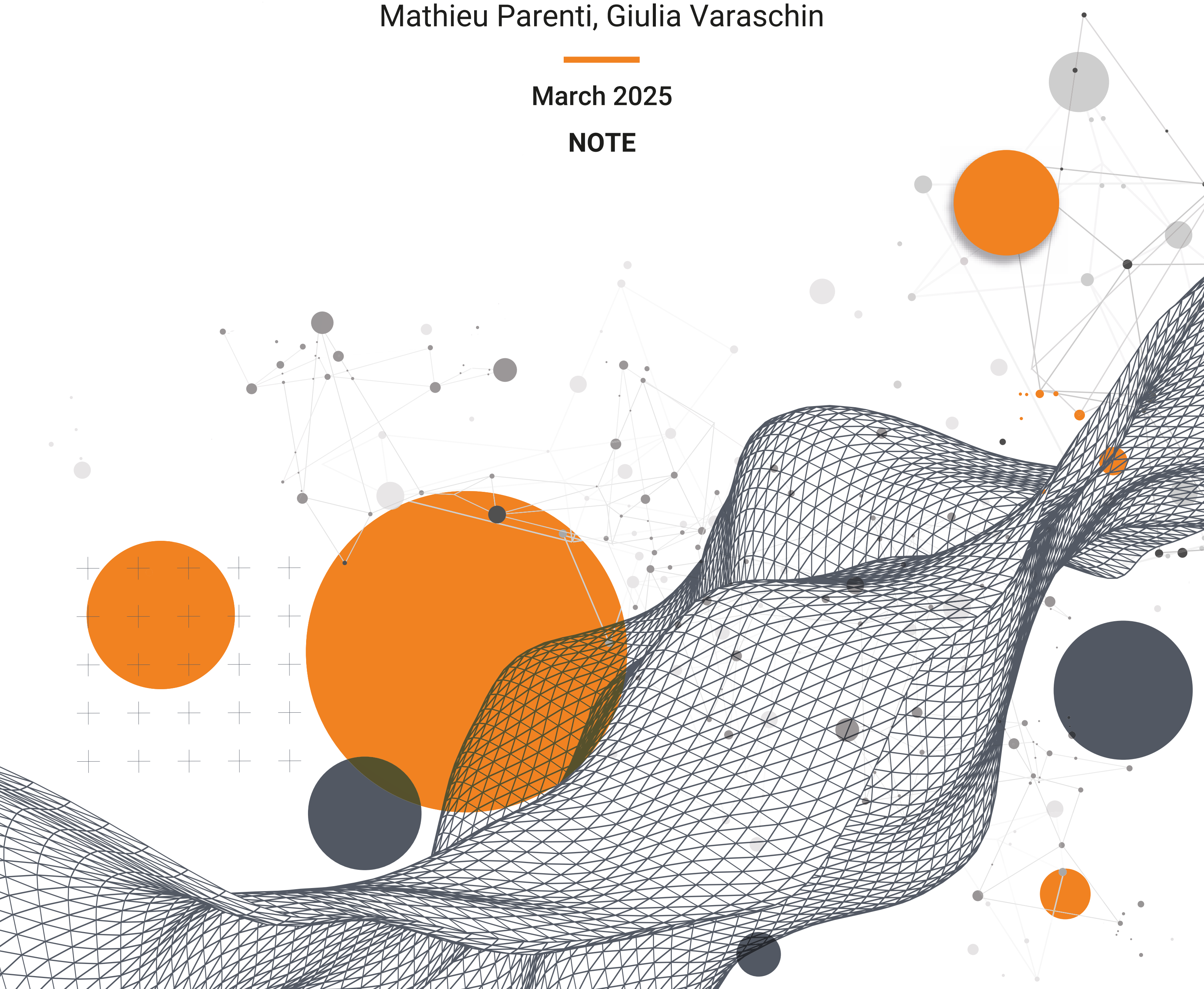

Abstract

EU policies promoting higher environmental standards in agriculture are often perceived as a challenge to the sector's economic competitiveness. However, well-designed policies can align the EU's environmental and economic goals, fostering sustainable and inclusive growth. This policy note examines the case of pesticide-reduction targets and finds that competitiveness trade-offs can be mitigated through complementary trade measures.

Our analysis highlights that 46% of pesticide use embedded in EU agricultural consumption comes from imports, despite them representing only 17% of the consumption. Particularly striking, a substantial amount of the pesticide use embedded in imports is represented by banned pesticides, exposing a blind spot in current trade policies. Without appropriate safeguards, stricter EU pesticide regulations can shift production to less-regulated markets, undermining global pesticide reduction efforts while disadvantaging EU agriculture. Analysing the potential for policy solutions, we consider different border-adjustment mechanisms, drawing parallels with the Carbon Border Adjustment Mechanism (CBAM).

Our findings indicate that such measures preserve EU agricultural competitiveness without compromising on environmental ambition. Aligning trade and environmental policies is therefore not only feasible but essential for effectively reducing global pesticide use while safeguarding EU agriculture.

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Introduction

In recent years, the European Union has positioned itself as a global leader in advancing ambitious environmental policies. This commitment is evident in the agricultural sector, where initiatives such as strict bans on harmful pesticides and pesticide reduction targets aimed at making food and farming systems more sustainable. However, these policies have often faced pushback due to concerns about their impact on the competitiveness of EU producers, sometimes leading to a dilution of the original proposals. This reflects a broader challenge in EU policymaking: **striking a balance between environmental ambition and economic viability, particularly in sectors exposed to international trade.**

Yet, **preserving competitiveness does not require lowering environmental standards.** Instead, well-designed policies can facilitate an alignment of both goals. When it comes to pesticides, a challenge is ensuring that stringent domestic regulations do not lead to leakage effects, where production shifts to countries with weaker environmental standards, undermining both the EU's sustainability objectives and its agricultural sector.

One solution is to align trade policy with environmental ambition. Recognizing this, the **European Commission's Vision for Agriculture and Food highlights the importance of applying EU production standards to imported goods**—especially for banned pesticides. This policy note explores solutions to achieve that objective, bridging the gap between environmental regulation, trade policy, and competitiveness.

Our analysis finds **that there is significant use of banned pesticides associated with EU consumption abroad**, underscoring the need to close regulatory loopholes in trade. Additionally, we estimate that a unilateral 50% pesticide-usage reduction in the EU —without corrective measures—would significantly increase imports from countries with weaker regulations, tilting further the playing field between foreign and EU producers.

To address this, border adjustment taxes can be leveraged to prevent pesticide leakage. We examine two potential approaches: a **Leakage Border Adjustment Mechanism (LBAM)**, and a **Phytosanitary Border Adjustment Mechanism (PBAM)**. LBAM imposes import tariffs to maintain the domestic market shares of EU producers to their pre-regulation level. In the vein of the Carbon Border Adjustment Mechanism (CBAM), PBAM prices the pesticide content in imported products, ensuring fair competition between EU and non-EU producers.

Aligning trade policy with environmental goals is crucial to **preserving EU competitiveness while maintaining high sustainability standards**. Rather than weakening regulations, well-designed policy instruments can prevent unfair competition, support resilient EU food production, and uphold environmental integrity in global markets.

The phytosanitary footprint: what is it and why it matters

Pesticides are chemical agents that control pests, weeds, and diseases in agriculture. While they play a critical role in maintaining crop yields, their use can generate significant externalities, including risks to human health, contamination of soil and water, and biodiversity loss. Similar to the carbon footprint, which quantifies the total greenhouse gas emissions embedded in production processes, the **phytosanitary footprint** measures the total load of pesticides used —both directly and indirectly—in the production of agricultural goods.

The concept is **valuable for addressing both environmental impact and competitiveness challenges in EU agriculture**. From an environmental perspective, it provides a key indicator of **pesticide dependency in EU agricultural consumption**. This allows for a more accurate detection and localisation of potential negative externalities[1] - such as soil degradation, water contamination, air pollution, and loss of biodiversity - which often occur in production countries but have global impact. For example, biodiversity loss was ranked as the third most severe threat humanity will face in the next 10 years in the World Economic Forum's Global Risks Report 2022[2]. Integrating this metric into trade policies would help preventing the outsourcing of environmental harm to exporting countries, ensuring that EU sustainability efforts extend beyond its borders.

From an economic perspective, it **highlights the competitiveness implications of EU pesticide reduction targets**. So far, EU regulations on pesticides applying to imported and domestic products primarily focus on residues rather than usage during production, by establishing Maximum Residue Limits (MRLs).[3] By comparing the footprints of imports and domestic production, it is possible to show how differences in regulatory standards shape agricultural practices and production costs. Producers operating under less stringent regulations can apply pesticides more intensively, while benefiting from lower compliance costs, meaning imports with higher phytosanitary footprint may have a competitive advantage over EU domestic products. Thus, the

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[1] It is worth noting that the phytosanitary footprint does not assess environmental harm directly, as the impact depends on the toxicity and persistence of each substance.

[2] World Economic Forum. The Global Risks Report 2022, 17th Edition.
https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf

[3] While MRLs allow to preserve food safety, they do not reflect the total amount of pesticides throughout the production process. This means that producers outside the EU can potentially apply pesticides at higher rates than EU farmers, as long as they still meet MRL thresholds.

phytosanitary footprint serves as a benchmark for understanding competitive imbalances in global agricultural trade.

In summary, incorporating the phytosanitary footprint into trade policy would allow for **better alignment between environmental regulations and market conditions**. It provides a basis for **policy adjustments**, such as **border measures**, that account for regulatory differences without distorting market access.

The phytosanitary footprint of EU consumption

To understand the scale of pesticide use linked to EU agricultural consumption, we provide an initial assessment of the phytosanitary footprint of both imports and EU domestic production. We firstly focus on one of the most widely used active substances[4] in pesticides: glyphosate. Later, we extend the analysis to paraquat. Finally, we consider a group of several active substances. While glyphosate remains permitted in the EU, many active substances such as paraquat are banned due to their hazardous nature. However, they continue to be allowed in several non-EU countries.

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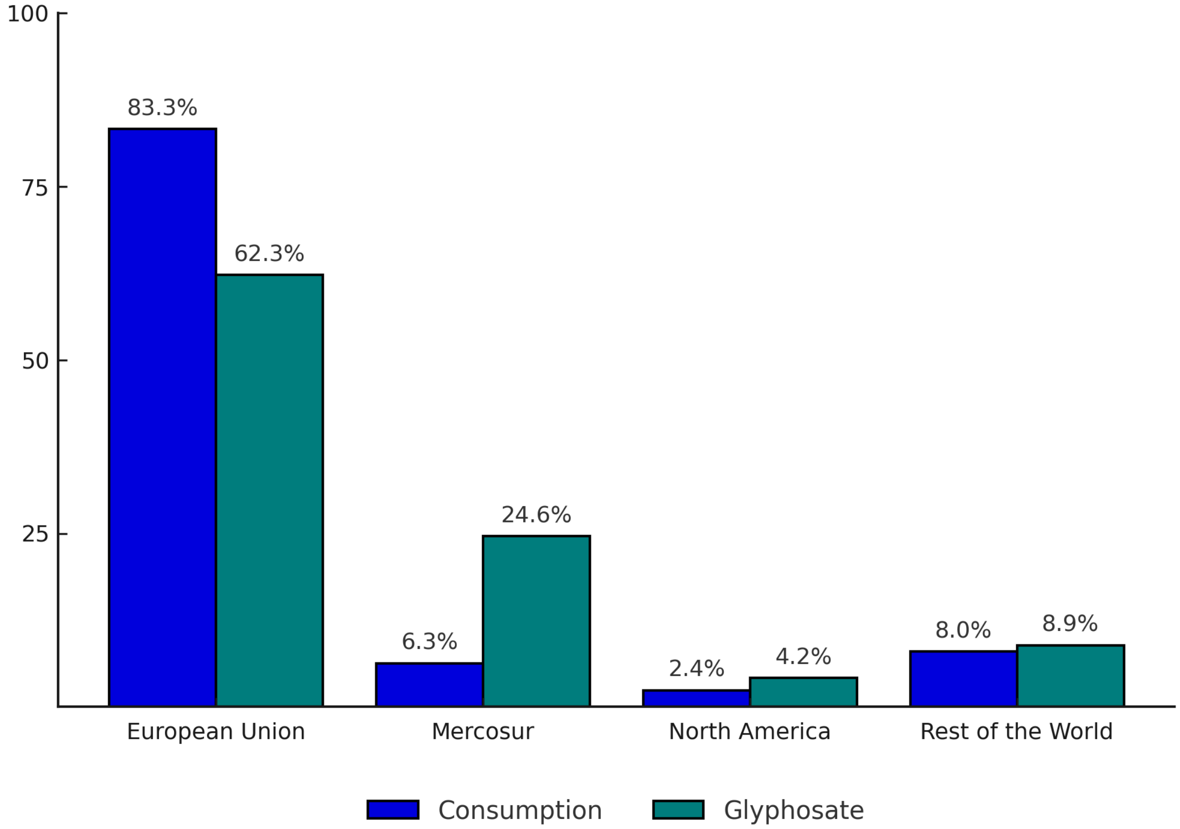
[4] An active substance is any chemical, plant extract, pheromone or micro-organism included in pesticides, that has an action against pests. Their applications occur at different stages of production and prevent yield reduction.

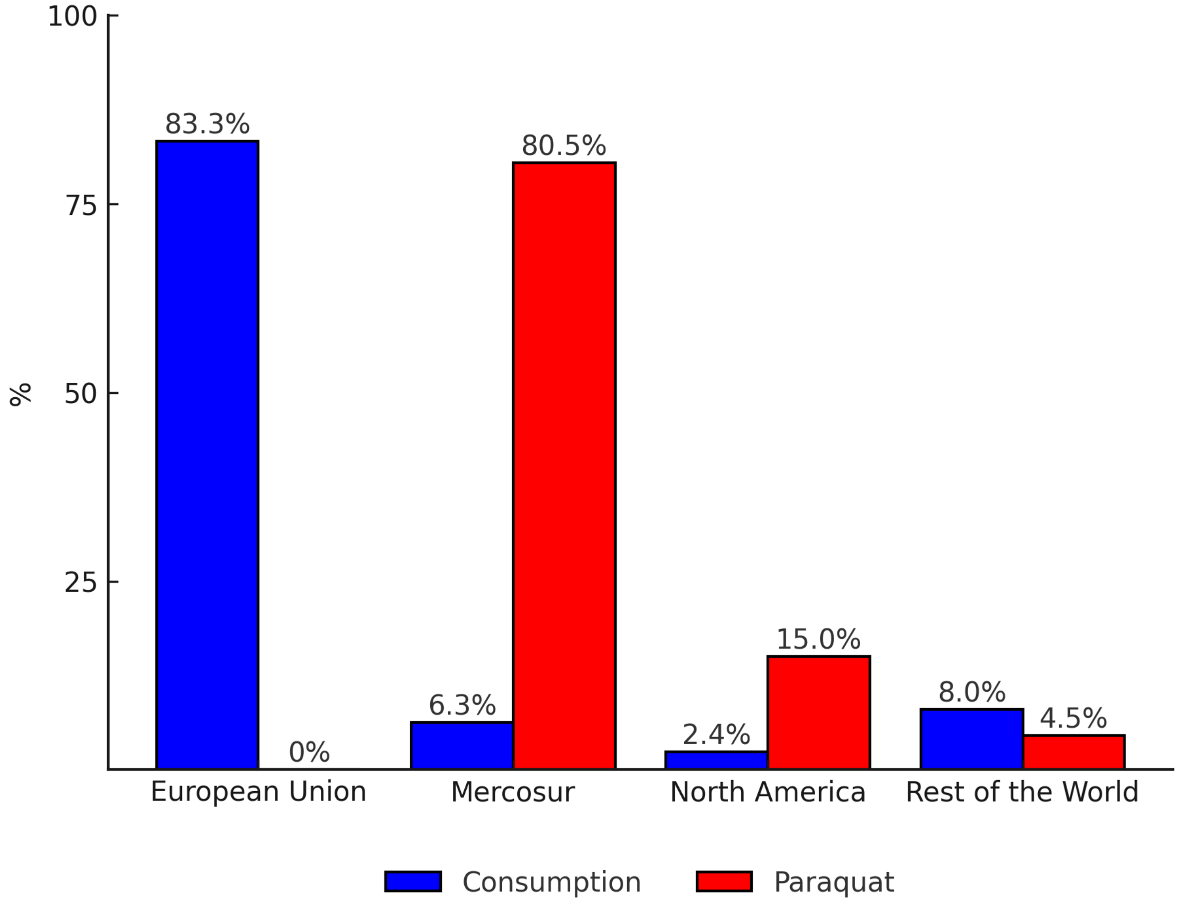
Figure 1: The Glyphosate Footprint of EU Consumption



Note: *The blue bars correspond to the EU aggregate consumption (in shares) of cereals (barley, maize, millet, oats, rice, rye, sorghum, wheat and other cereals) and oil crops (groundnuts, oil palm, rape and mustardseed, soybeans, sunflower seed and other oilcrops) by region of origin. The green bars correspond to the amount of glyphosate (in shares) embedded in EU consumption by region of origin. The region "European Union" includes EU27 and UK; "Mercosur" includes Argentina, Brazil, Paraguay and Uruguay; "North America" includes US and Canada; "Rest of the World" includes all the other countries. For further details, see the Appendix.*

The results of our analysis are striking. The EU primarily relies on domestic production for its agricultural consumption, with **non-EU suppliers—led by Mercosur—accounting for about 16.7% of total consumption** (Figure 1). However, when looking at glyphosate use, the distribution tells a different story. Despite making up a small share of overall consumption, **non-EU imports account for a disproportionate share of the EU's glyphosate footprint**. Of the 96,058 tonnes of glyphosate embedded in EU agricultural consumption, 37.7% originates from outside the EU. Mercosur alone contributes 23,592 tonnes, representing 24.6% of the total EU glyphosate footprint. Additionally, imports from North America and other non-EU regions show similarly a high glyphosate content of their exports to EU countries. This indicates that, on average, non-EU producers apply glyphosate at a higher rate per unit of output compared to EU producers.

Figure 2: The Paraquat Footprint of EU Consumption



Note: *The blue bars correspond to the EU aggregate consumption (in shares) of cereals (barley, maize, millet, oats, rice, rye, sorghum, wheat and other cereals) and oil crops (groundnuts, oil palm, rape and mustardseed, soybeans, sunflower seed and other oilcrops) by region of origin. The red bars correspond to the amount of paraquat (in shares) embedded in EU consumption by region of origin. The region "European Union " includes EU27 and UK; "Mercosur" includes Argentina, Brazil, Paraguay and Uruguay; "North America" includes US and Canada; "Rest of the World" includes all the other countries. For further details, see the Appendix.*

The paraquat footprint of EU consumption is even more striking as the herbicide is banned in the EU[5]. About **530 tonnes of paraquat are used to produce agricultural commodities consumed in the EU**. Despite the relatively lower number compared to glyphosate, the toxicity of paraquat is dramatically higher. For instance, it displays an acute oral lethal dose (LD50) 18 times lower than glyphosate (110 vs 2000 mg/kg) and an acceptable daily intake (ADI) 125 times lower (0.004 vs 0.5mg/kg bw/day)[6]. This contrast between import volumes and toxicity profiles emphasizes the importance of considering not just the quantity but also the hazard level of pesticides in agricultural trade.

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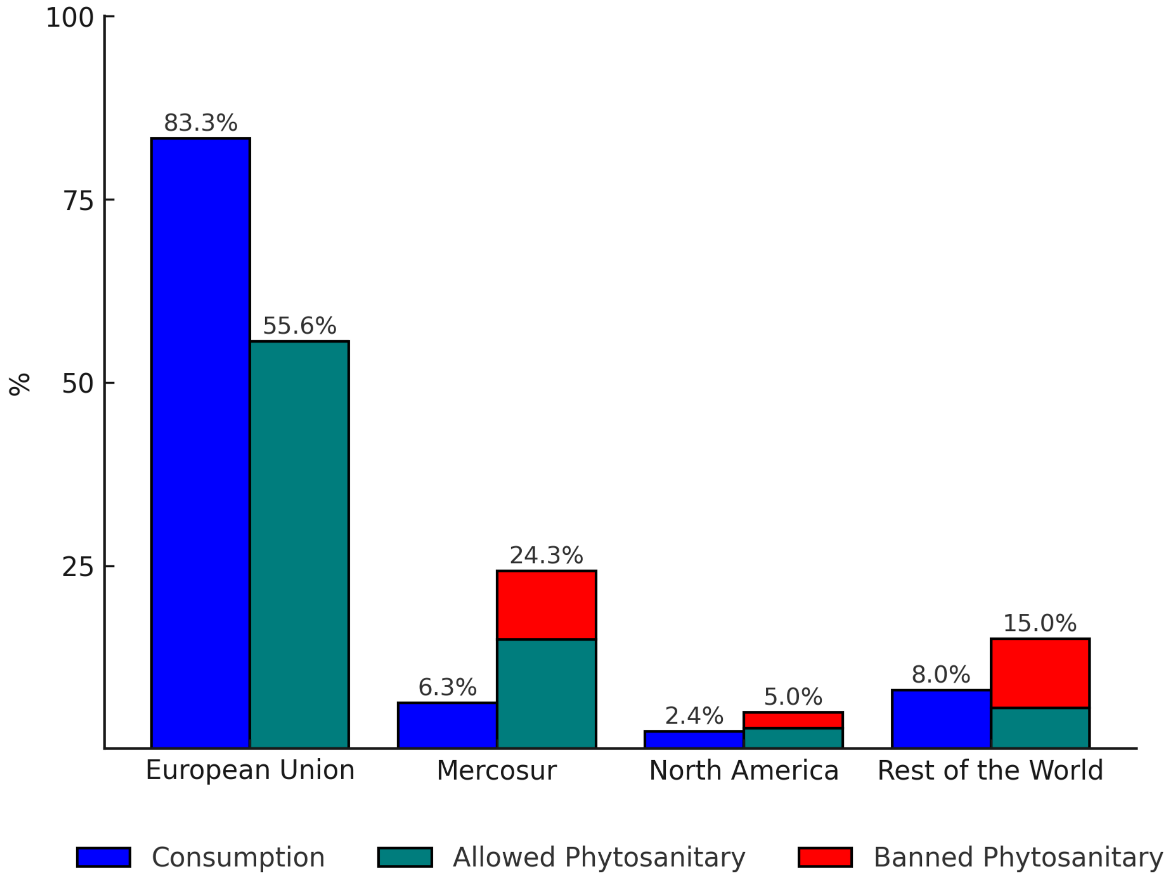
[5] cf.Regulation (EC) No 1107/2009.

[6] Data on toxicity measures are provided by the Pesticide Properties Database (PPDB, https://sitem.herts.ac.uk/aeru/ppdb/en/index.htm).

Figure 3: The Phytosanitary Footprint of EU Consumption



Note: *The blue bars correspond to the EU aggregate consumption (in shares) of cereals (barley, maize, millet, oats, rice, rye, sorghum, wheat and other cereals) and oil crops (groundnuts, oil palm, rape and mustardseed, soybeans, sunflower seed and other oilcrops) by region of origin. The red bars correspond to the aggregate amount of glyphosate-equivalent EU-banned active substances (in shares) embedded in EU consumption by region of origin. The green bars correspond to the aggregate amount of glyphosate-equivalent EU-allowed active substances (in shares) embedded in EU consumption by region of origin. Each amount of active substance is computed in tonnes of glyphosate equivalent by using the "acute oral median lethal dose" (LD50). The region "European Union " includes EU27 and UK; "Mercosur" includes Argentina, Brazil, Paraguay and Uruguay; "North America" includes the US and Canada; "Rest of the World" includes all the other countries. For further details, see the appendix.*

To investigate further, we consider a broader set of 32 active substances which accounts for a significant share of overall use[7]. Among them, 19 active substances are actually banned in the EU. The Phytosanitary footprint of EU consumption (Figure 3) represents the aggregate amount of glyphosate equivalent[8] active substances embedded in EU consumption. As can be observed, the figures are even more salient. A large share of the EU's phytosanitary footprint is related to imports from non-EU

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[7] For the detailed list of all the active substances considered, see the Appendix.

[8] To have an approximative metric when aggregating different active substances, we use a toxicity measure. Each amount of active substance is computed in tonnes of glyphosate equivalent by using the "acute oral median lethal dose" (LD50). For instance, the toxicity of paraquat is dramatically higher than the one of glyphosate (150 vs 2000 mg/kg). According to this metric, one tonne of paraquat corresponds to about 18 tonnes of equivalent glyphosate. This provides us a broad overview, however alternative measures could be used to aggregate active substances quantities.

countries. Despite many substances being banned in the EU, more than **54,914 tonnes of glyphosate-equivalent banned active substances are embedded in final goods consumed in the EU**. This represents around a fifth of the total EU phytosanitary footprint. Furthermore, around half of this amount is related to production in Mercosur countries.

These findings highlight a key challenge: while the EU is reducing pesticide use domestically, a **significant share of its agricultural footprint remains tied to imports from regions with higher pesticide application rates and/or more toxic substances**.

Policy implications: a blind spot in EU trade policies

The evidence presented in Figures 1, 2, and 3 highlights a **significant phytosanitary footprint for products imported from outside the EU**, raising concerns about inconsistencies between the EU's pesticide regulations and trade policies. Current environmental proposals focus primarily on domestic pesticide reduction, overlooking the fact that a large share of the EU's agricultural footprint is embedded in imports. At the same time, **current pesticide policies, like MRLs, with their focus on products rather than processes, fail to internalise the phytosanitary footprint of agricultural products**. As a result, EU agricultural production might be already negatively affected. Finally, the impact of reduction targets on the pesticide use linked to EU consumption is reduced, while putting EU domestic production at a competitive disadvantage.

The issue lies not in trade itself, but rather in the regulatory disparity between the EU and its trading partners. Farmers in countries with weaker environmental standards face lower costs, allowing them to produce at a lower price. This creates a risk that EU consumers shift toward cheaper imports produced with more intensive pesticide use, effectively outsourcing environmental harm rather than reducing it. This **phytosanitary leakage** phenomenon mirrors carbon leakage, where strict EU climate policies can lead to the relocation of emissions-intensive production to countries with weaker environmental standards, undermining overall policy effectiveness.

A key example could be the recently signed EU-Mercosur trade deal, which facilitates imports from a region that accounts for the highest phytosanitary footprint of the compounds analyzed. Increasing market access for Mercosur imports risks exacerbating this overall pesticide footprint and banned pesticides use, undermining the EU's sustainability goals on a global scale.

To avoid such contradictions, trade policies must be realigned with environmental objectives, ensuring that ambitious domestic regulations are not offset by increased imports from countries with weaker standards.

Fixing the leak: a border-adjusted pesticide tax

A key step to curb phytosanitary leakage is the introduction of **border adjustment measures**. These mechanisms aim to prevent a regulatory race to the bottom by ensuring that stricter EU pesticide targets do not lead to competitive disadvantages for domestic producers or an increase in imports from countries with weaker regulations.

As previously shown, market mechanisms fail to account for the environmental benefits of sustainable agricultural practices, allowing producers in less-regulated regions to maintain lower costs and gain a competitive edge. In this context, border instruments that reduce leakage are not **market-distorting**, but market-correcting, ensuring that global trade dynamics support, rather than undermine, sustainability efforts. The EU has already applied similar principles in other sectors (notably with the Carbon Border Adjustment Mechanism), and it is crucial that policies focused on phytosanitary products follow suit.

Border adjustments can take different forms to mitigate competitive distortions while reinforcing environmental objectives. One approach, the **Leakage Border Adjustment Mechanism (LBAM)**, applies tariffs on agricultural imports based on the **cost disadvantage** faced by EU producers due to stricter pesticide regulations.[9] This measure can be designed to maintain relative market access, levelling the playing field between imports and domestic production and avoiding competitive distortions. However, it does not directly target the externality.

Another approach, the **Phytosanitary Border Adjustment Mechanism (PBAM)**, mirrors the Carbon Border Adjustment Mechanism (CBAM) by pricing the **pesticide content** embedded in imported products. **This measure directly targets environmental externalities, potentially creating a virtuous cycle that encourages exporting countries to align with EU standards**. However, implementation poses challenges, particularly in tracking pesticide content and preventing loopholes, where exports are rerouted through countries with weaker environmental regulations to bypass restrictions.[10]

The effects of border-adjustments: a preliminary estimation

We analyze the **impact of a 50% reduction in pesticide use**, as originally outlined in the EU's Farm-to-Fork strategy. Our assessment considers a scenario in which this target is achieved through both lower pesticide application rates and changes in EU agricultural production. The analysis focuses on three major crops—corn, soybeans, and wheat—and examines the effects of pesticide reduction on EU prices, import shares, and the overall phytosanitary footprint.

We begin by assessing the case in which EU trade policy remains unchanged. We then compare these results with two potential border tax mechanisms: the Level-Based

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[9] Campolmi et al. (2024) provide a detailed discussion of Leakage Border Adjustment Mechanisms (LBAM) vis à vis EU's CBAM.

[10] See Fontagné and Schubert (2023) for an economic analysis of CBAM.

Adjustment Mechanism (LBAM) and the Pesticide-Based Adjustment Mechanism (PBAM)[11].

Table 1

Simulation Results

		No Trade Policy	LBAM	PBAM
Corn	Application rate	-39.6%	-42.0%	-43.2%
	Import share	+8.3%	0.0%	-4.4%
	Phytosanitary footprint	-31.1%	-32.2%	-34.2%
Soybeans	Application rate	-27.1%	-35.4%	-48.7%
	Import share	+1.9%	0.0%	-4.4%
	Phytosanitary footprint	+1.3%	-0.4%	-27.1%
Wheat	Application rate	-32.0%	-34.2%	-35.8%
	Import share	+30.2%	0.0%	-22.0%
	Phytosanitary footprint	-32.2%	-32.2%	-33.4%

Note: *Table 1 reports the simulation results related to a 50% reduction in EU pesticide use for each crop (corn, soybeans and wheat). The estimates are provided under three policy scenarios. "No Trade Policy" refers to the case where no border tax measures are introduced together with the stricter pesticide regulation. "LBAM" and "PBAM" refer to two different border tax mechanisms. The former aims at keeping the EU import shares constant. The latter aims at taxing the pesticide content of imports. The outcome variables are changes in "Application rate" (i.e., the total amount of glyphosate equivalent substances used to produce one kg of crop by EU producers), "Import share" (i.e. the share of imported crops in total EU consumption) and "Phytosanitary footprint" (i.e., the total amount of glyphosate-equivalent active substances, both banned and not banned, embedded in EU consumption).*

Table 1 presents the results across three scenarios: "No Trade Policy," "LBAM," and "PBAM." Without any alignment in EU trade policy (column 1), **implementing the reduction in EU pesticide use would lead to an increase in EU import shares by 8.3%, 1.9%, and 30.2%** for corn, soybeans, and wheat, respectively. This outcome is driven by rising domestic prices, which reduce the competitiveness of EU production relative to non-EU producers. Additionally, the overall reduction in pesticide use would fall short of 50% since part of the decline comes from reduced production rather than technological changes. Moreover, the phytosanitary footprint for corn and wheat would also decline by less than 50%, as increased reliance on foreign suppliers—who

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[11] To conduct this analysis, we employ a simplified Armington model enriched with trade data, crop- and country-specific pesticide application rates, and balance sheet information for both conventional and organic farming. Full details on the methodology and data sources are provided in the Appendix.

typically employ more pesticide-intensive farming practices—partially offsets the EU's reduction. In the case of soybeans, the shift toward imports would even lead to a worsening of the EU phytosanitary footprint.

The introduction of LBAM, a border measure designed to maintain pre-regulation import shares, would prevent shifts in trade patterns. Under this mechanism, the EU would implement an ad-valorem top-up tax on agricultural imports, estimated at approximately 10.4% for corn, 21.2% for soybeans, and 10.7% for wheat. By preserving EU producers' competitiveness, **this policy would allow for a greater reduction in pesticide application rates and lead to a more significant improvement in the phytosanitary footprint compared to the "No Trade Policy" scenario**. However, **the effectiveness of this trade policy on phytosanitary footprint reduction is highly dependent on the initial import shares** for each crop, as shown by column 2.

Finally, we consider PBAM, a trade policy that imposes an equal tax on pesticide use for both domestic and foreign producers. Given that imported crops typically contain higher pesticide residues than domestically produced ones, **PBAM would enhance the competitiveness of EU farmers on the domestic market**. Indeed, **contrary to our LBAM scenario that maintains leakage at its current level, PBAM corrects it**. As a result, import shares for all three crops would decline. Furthermore, the reduction in the EU's overall phytosanitary footprint would be larger than under not only the "No Trade Policy" but the "LBAM" scenario as well[12].

Competing abroad: considerations for EU exports

Our results demonstrate that EU competitiveness can be preserved through appropriate border adjustments. A similar mechanism may operate for foreign markets: to maintain competitiveness, an export subsidy or at minimum an exemption for exporters might be necessary. However, the case for such adjustment is not straightforward for at least three reasons.

First, by implementing the border policy for imports as described above, EU internal demand will shift toward EU production, meaning that potential losses in export competitiveness must be weighed against increased domestic market share.

Second, by encouraging foreign countries to raise their standards,[13] EU exporters would face reduced adjustment costs to non-EU standards.

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[12] For the PBAM scenario, our results do not consider the possible decrease in non-EU pesticide application rates following the implementation of PBAM. Hence, they represent a lower bound of the reduction in phytosanitary footprint, which would likely be higher.

[13] See "Promoting the Global Transition" in the Farm to Fork Strategy.

Third, unlike the import case where competitiveness and environmental goals align, the optimal export policy would require further considerations to balance environmental costs against preserved international competitiveness.

Overall, while various policies can support exporters, determining the optimal approach is more complex than for imports, as it depends more heavily on policy preferences; nevertheless, with careful analysis and consideration of specific economic conditions, identifying effective export promotion strategies remains feasible.

Conclusion

The EU has been working towards greater sustainability in agriculture. However, without trade policy alignment, these efforts risk being undermined by leakage effects —shifting pesticide-intensive production outside the EU rather than reducing overall global pesticide use. This not only weakens environmental effectiveness but also places EU producers at a competitive disadvantage.

Our analysis highlights that a significant amount of the pesticide use associated with EU agricultural consumption occurs outside the EU, with regions like Mercosur playing a disproportionately large role. The current regulatory framework, which focuses on Maximum Residue Limits (MRLs) in food, fails to capture the full environmental impact of pesticide use in production. As a result, imported agricultural products can comply with EU food safety standards while relying on significantly higher pesticide application rates—creating a loophole that both harms sustainability efforts and distorts competition for EU farmers.

To address these challenges, border-adjustment measures should be integrated into the EU's trade policy to ensure that stricter environmental regulations do not unintentionally favor imports from less regulated markets. A Leakage Border Adjustment Mechanism (LBAM) could offset the competitive disadvantage faced by EU farmers by applying an ad-valorem tariff on imports, preventing market distortions while maintaining trade access. However, a Phytosanitary Border Adjustment Mechanism (PBAM) would have even more far reaching effects, directly pricing the pesticide content embedded in imported agricultural goods, ensuring that both domestic and foreign producers face the same environmental cost.

Preliminary estimates indicate that without trade policy adjustments, a 50% pesticide reduction in the EU would shift imports toward pesticide-intensive producers. Implementing an LBAM or a PBAM would safeguard EU production while reducing the phytosanitary footprint of EU consumption.

As the EU redefines its policies under the new Parliament and Commission, it must ensure that domestic environmental efforts are reinforced by trade measures that prevent leakage. Well designed policies would not only safeguard EU competitiveness but also create stronger incentives for global pesticide reduction, helping align trade policy with both environmental ambition and economic resilience.

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