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SCIENTIFIC ARTICLE

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# Recent trends in agri-food trade and the future in a changing geopolitical environment

**ABSTRACT**

Global agri-food trade is undergoing profound structural change, driven by escalating geopolitical tensions, climate-related shocks, and evolving market dynamics. Agri-food trade has become central to food security, shaping access and availability across diverse regions. Recent trends indicate a modest resurgence in agricultural trade as a share of total global trade and a growing regionalisation of trade flows. While the European Union and Brazil have consolidated surplus positions through strategic policy alignment and export diversification, the United States faces declining competitiveness, trade stagnation, and a widening import gap. Simultaneously, China has emerged as the leading global importer, reshaping trade relationships and intensifying competition among suppliers. The volatility induced by trade wars, the COVID-19 pandemic, and the war in Ukraine has been compounded by the proliferation of trade restrictions, which pose acute risks for import-dependent countries. These developments underscore the fragility of global food systems and the strategic implications of trade balances. As trade agreements are reconfigured and economic nationalism rises, long-term sustainability will hinge on investments in domestic agricultural capacity, modern infrastructure, and multilateral cooperation. Future trajectories of agri-food trade will be shaped by structural shifts in global demand, persistent trade costs – including tariffs, transportation bottlenecks, and non-tariff measures – and the increasingly complex intersection of environmental regulation and market access. With agricultural production projected to increase by over 21% globally in the next decade, addressing the compound pressures of geopolitical fragmentation and climate change will be essential to maintaining stable, equitable, and sustainable food systems.

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## Introduction

The landscape of agri-food trade has been shaped significantly by historical events and geopolitical dynamics that have influenced countries' comparative advantages and designed trade routes (Anderson, 2014). Colonial and neo-colonial legacies have left enduring patterns of dependency and inequality, particularly in the Global South where bulk, low-valued commodities are largely exported (Horner and Nadvi, 2018). These historical patterns have led to structural dependencies that continue to affect food security, rendering many nations vulnerable to external shocks and market manipulation (d'Amour and Anderson, 2020; Hellegers, 2022). The concept of food systems encompasses a complex network of activities necessary for feeding a population, including production, processing, distribution, and consumption (Pinstrup-Andersen, 2009; Santeramo, 2015; Clapp, 2022). These systems have historically been influenced by external agricultural policies, perpetuating cycles of dependency that affect contemporary food security challenges (Smith and Glauber, 2020). Moreover, the interaction between agricultural trade and global capital flows has further complicated the agri-food landscape. The geopolitical environment continues to evolve, with significant disruptions in trade patterns occurring due to trade wars, supply chain issues from the COVID-19 pandemic, and ongoing conflicts such as the Russia-Ukraine war, all of which have altered trading dynamics and introduced new challenges (Awokuse *et al.*, 2024; Kornher *et al.*, 2024). The significance of agri-food trade extends beyond mere economic transactions; it is pivotal for global food security, impacting billions of lives worldwide (Godfray *et al.,* 2010). As nations navigate a complex web of trade agreements and barriers, understanding these trends is essential to ensure stable food supplies and address vulnerabilities, particularly for nations in the Global South that remain heavily reliant on imports (Savary *et al.,* 2022). The past few years have seen a notable shift towards regionalisation in agri-food exchanges, and for agricultural trade, after years of decreasing as a proportion of total trade, the tendency is now steady with a slight increase observable over the last 15 years (Piñeiro and Piñeiro, 2024).

The United States is the world's second largest agricultural trader, behind the European Union (EU), with emerging pressure from increasing imports and competition of emerging markets like Brazil and Argentina[1]. Moreover, geopolitical events such as trade wars, the COVID-19 pandemic, and the ongoing conflict in Ukraine have profoundly disrupted established trade patterns[2], resulting in price volatility and complicating supply chains (Awokuse *et al.,* 2024; Kornher *et al.*, 2024), and trade has been further disrupted by trade restrictions[3]. Controversies surrounding trade restrictions have emerged (Larch *et al.,* 2024). These measures raise concerns about food accessibility and security, especially for vulnerable countries, endangering their food security (Afesorgbor *et al.,* 2024a). Furthermore, geopolitical tensions have catalysed a re-evaluation of trade agreements. The future of agri-food trade hinges on strategic collaboration, investments in local production, and enhanced infrastructure to foster resilience against external shocks (Awokuse *et al.,* 2024). As global agricultural production is projected to increase by over 21% in the next decade, addressing the interconnected challenges of geopolitical dynamics and climate change will be crucial for maintaining food security and stability in the agri-food sector.

## Shifting Global Agri-Food Trade Balances

Global agri-food trade has experienced significant transformations over the past two decades, influenced by shifting geopolitical landscapes, evolving consumer preferences, climate variability, and changing production capacities. Central to this transition is the reconfiguration of trade balances among the world's major exporters and importers, signalling broader structural shifts in the global food system. Regions such as the European Union and Brazil have recorded notable increases in export volumes and surpluses, while the United States – traditionally a dominant agricultural power – has witnessed a relative stagnation in exports and a widening import gap. Simultaneously, China has emerged as a major structural driver of global import demand, further altering traditional trade flows and supplier dynamics (Table 1).

The EU has consolidated its status as one of the most competitive and diversified agri-food exporters globally[4]. In 2024, the EU27's exports to countries outside the Union reached €235.4 billion, an increase of 2.9% over the previous year, while imports rose by 7.8% to €171.9 billion. The resulting trade surplus of €63.5 billion underlines the region's robust external position in agri-food markets. This performance has been underpinned by successive reforms of the Common Agricultural Policy (CAP), which have enhanced productivity, market responsiveness, and sustainability. The EU's top export categories – cereal preparations and milling products (€24.8 billion), dairy products (€19.7 billion), and wine and wine-based products (€17.4 billion) – reflect not only high output levels but also a strategic focus on value-added goods. Premium exports such as chocolate and confectionery (€11.8 billion, +9.7%) and coffee, tea, cocoa, and spices (€10.7 billion, +32%) have also recorded significant growth, driven by global demand for specialty foods with traceable and certified origins.

Despite the rise in imports – especially of tropical and seasonal products – the EU has preserved a positive balance. The most imported agri-food products in 2024 were coffee, tea, cocoa, and spices (€30.3 billion, +47.5%), fruit and nuts (€24.9 billion, +11.6%), and oilseeds and protein crops (€20 billion, -5.2%). These figures highlight both the EU's global integration and its dependence on agricultural products not widely produced within its borders. Nonetheless, its strong export orientation, complemented by preferential trade agreements and efficient logistics, positions the EU as a resilient actor in the global agri-food system.

Brazil has similarly emerged as a formidable agri-food exporter, particularly in commodities such as soybeans, beef, poultry, and sugar. In 2024, Brazil's agri-food exports surpassed $100 billion, a dramatic rise from approximately $20 billion in 2010. This fivefold growth is a result of extensive agricultural land resources, cost-effective production systems, and increasing productivity. Brazil has strategically expanded its presence

**Table 1: Key Global Agri-Food Trade Statistics in USD bn (2024).**

| Country | Exports | Imports | Key Export Categories |
|---|---|---|---|
| EU27 | 235 | 170 | Cereals, dairy, wine, confectionery |
| Brazil | 100 | 150 | Soybeans, beef, poultry, sugar |
| United States | 197 | 200 | Grains, meat, soybeans, processed foods |
| China | 103 | 200 | Soybeans, dairy, fruit, meat |
| India | 50 | 35 | Rice, spices, tea, seafood |
| Argentina | 60 | 10 | Soy products, meat, maize |

Source: Author's elaboration from data retrieved from WTO and COMEXT

[1] Data available form the Global Trade Alert database, available at: https://global-tradealert.org/

[2] Notably, during this tumultuous period, the grain and oilseed trade demonstrated remarkable resilience as importers sought alternative suppliers and adjusted inventory management practices in response to fluctuating supply conditions.

[3] Data recovered from the WTO World trade in agricultural products, available at: https://www.wto.org/english/tratop_e/agric_e/ag_imp_exp_charts_e.htm

[4] Data are retrieved from https://agriculture.ec.europa.eu/system/files/2023-05/agri-food-extra-eu27_en.pdf

in Asian markets – most notably China – which now absorbs a significant share of its soybean and meat exports. Geopolitical tensions, including trade disputes among other major players, have further enhanced Brazil's role as a reliable supplier in times of global disruption. With favourable climatic conditions and continued government investment in infrastructure, Brazil is likely to increase its market share in global exports over the next decade, especially in high-demand commodities.

Conversely, the United States has experienced a notable shift in its agri-food trade trajectory. While historically among the world's largest net agricultural exporters, the U.S. recorded a trade deficit of approximately $3 billion in 2022 – the first in decades – compared to a surplus of $40 billion in 2010. Imports have steadily climbed to around $200 billion, driven by rising consumer demand for fresh, organic, and specialty products not always produced domestically. Meanwhile, exports have plateaued around $197 billion, partly due to the strong U.S. dollar, which makes American goods more expensive on global markets.

This trend is compounded by stagnation in trade diplomacy. Unlike the EU and emerging exporters such as Brazil, the United States has not concluded significant new trade agreements in recent years, limiting its access to fast-growing markets. Trade tensions – particularly with China – have also disrupted longstanding export channels. For instance, retaliatory tariffs on soybeans and other agricultural goods during the 2018–2020 trade conflict led China to increase its reliance on Brazilian suppliers, reshaping long-term trade flows. Domestically, regulatory complexity, fragmented policy responses, and limited infrastructure investment have further inhibited the international competitiveness of the U.S. agri-food sector.

In parallel, China has emerged as the world's most significant agri-food importer. In 2024, its total imports exceeded $200 billion, reflecting structural challenges such as limited arable land, rapid urbanisation, and changing dietary patterns. China's key import categories include soybeans, dairy products, meat, and fruit. Its demand for these products has not only transformed global trade flows but also elevated the strategic importance of suppliers like Brazil, Argentina, and the EU. In response to previous supply shocks – most notably during the trade dispute with the United States – China has adopted a diversification strategy, establishing long-term import relationships to reduce overdependence on a single partner. As a result, China has become not only a major consumer but also a critical actor shaping the direction and distribution of global agri-food trade.

The agri-food trade balance, in this context, functions as a barometer of structural competitiveness, policy coordination, and market access. Countries maintaining positive trade balances typically exhibit several key characteristics: a diversified export portfolio that includes value-added goods; reliable and efficient logistics; access to multiple preferential markets; strong national branding; and alignment between agricultural, trade, and environmental policies. These elements are evident in the agri-food strategies of both the EU and Brazil.

In contrast, regions experiencing trade balance deterioration often face overreliance on a narrow range of exports, limited investment in food processing and infrastructure, and reduced adaptability to geopolitical shocks. The U.S., while still a leading exporter in absolute terms, exemplifies how strategic stagnation and reactive policy approaches can lead to an erosion in trade performance.

Looking ahead, the future of agri-food trade will depend on the capacity of nations to navigate intersecting global challenges – ranging from climate change and supply chain vulnerabilities to geopolitical instability and shifts in consumer behaviour. Maintaining a favourable trade balance is no longer a mere economic metric; it is an expression of resilience, adaptability, and strategic foresight. Countries must prioritise investment in sustainable production, value-chain integration, and multilateral trade engagement to remain competitive in a global food economy increasingly characterised by volatility and interdependence.

In sum, the rebalancing of global agri-food trade reflects not only competitive market dynamics but also broader questions of sovereignty, sustainability, and security. As food systems become more integrated and exposed to global shocks, the trade balance serves as a critical indicator of national preparedness to ensure food availability, affordability, and political influence in an interconnected world.

## Food System Transformation in the Context of Global Food Security

Global agricultural production is projected to grow by 21.4% over the next decade, driven by increased investment and technological advancements (OECD–FAO, 2025). However, this expansion will not be evenly distributed across regions and is expected to interact with evolving trade patterns and structural shifts. The United States, for example, is anticipated to see a decline in its share of global agricultural exports – from 34% to 29.5% by 2030 – reflecting intensifying competition from emerging exporters such as Brazil and Argentina (USDA, 2025).

Simultaneously, global food demand is projected to rise by approximately one percentage point per year, primarily fuelled by population growth in low- and middle-income countries. In contrast, high-income countries are expected to see relatively stable levels of food consumption, owing to demographic stagnation and dietary saturation (Barrett *et al.,* 2022). These trends underscore ongoing structural transformations within the global food system – affecting labour allocation, trade flows, technological diffusion, and logistical infrastructure (Reardon *et al.,* 2021; Afesorgbor *et al.,* 2025).

According to the OECD–FAO (2025), per capita demand growth for most agricultural commodities will remain limited, with dairy products being a notable exception. Population growth in regions such as Sub-Saharan Africa, South Asia, and the Near East and North Africa will account for the bulk of overall demand increases. This demographic shift will place additional pressure on national food systems, especially in

**Table 2: Number of Severely Food Insecure People (in millions) by region (2014–2023).**

| Region | 2014 | 2023 | Absolute Change | Relative Change (%) |
|---|---|---|---|---|
| Africa | 191.2 | 315.5 | +124.3 | +65% |
| Asia | 313.5 | 467.3 | +153.8 | +49% |
| Central America | 10.8 | 13.8 | +3.0 | +28% |
| Europe | 10.9 | 14.6 | +3.7 | +34% |
| Northern America | 3.7 | 3.7 | 0.0 | 0% |
| Oceania | 3.3 | 4.7 | +1.4 | +42% |
| South America | 16.2 | 31.6 | +15.4 | +95% |

Source: Author's elaboration from data retrieved from FAO

terms of logistics and international trade. Currently, approximately 80% of global food consumption is sourced domestically. This share is likely to increase further in developing countries, where local production will be critical for meeting food security needs. Nonetheless, international trade will continue to play a central role in stabilising markets, particularly in regions with structural food deficits (FAO, 2018).

The urgency of these dynamics is underscored by recent trends in food insecurity across regions. Between 2014 and 2023, the number of severely food insecure people rose sharply in every continent except North America, where levels remained constant. Africa and Asia accounted for the largest absolute increases, adding 124.3 and 153.8 million severely food insecure individuals, respectively, while South America recorded the most dramatic relative increase (+95%) (see Table 2). These figures highlight a troubling decoupling between aggregate food availability and individual food access. They reflect both structural vulnerabilities and the inadequacy of current systems to deliver food to all populations equitably. Even in regions with rising agricultural output, widespread insecurity persists, pointing to systemic failures in distribution, affordability, and resilience.

While global commodity prices have softened and markets remain largely stable, the World Bank's June 2025 data highlights a disconnect between international trends and local realities. High domestic food inflation persists across low- and middle-income countries, undermining household purchasing power despite falling global prices. In Africa, logistical inefficiencies exacerbate the challenge, with over one-third of perishable foods lost in transit due to inadequate infrastructure. This situation reinforces the importance of complementary investments in supply chain logistics, cold storage, and domestic market efficiency to realise the full benefits of international trade and rising global output. Additionally, the continued prevalence of acute food insecurity in several regions despite favourable global trends suggests that access – not just availability – remains a core issue in global food systems (World Bank, 2025).

A key feature of this transformation is the growing role of services and technological innovation across agri-food value chains. Service-oriented activities such as logistics, quality control, and input provision are increasingly central to competitiveness in global markets (Reardon, 2015; Swinnen and Kuijpers, 2019; Manghnani *et al.,* 2021). Meanwhile, the adoption of digital tools, precision farming technologies, and data-driven crop management systems is enhancing productivity and resilience across supply chains (Santeramo *et al.,* 2024). In this context, international trade is no longer solely about the movement of commodities; it also enables the diffusion of technology, standards, and knowledge, thereby contributing to the development of more nutrition-sensitive and environmentally resilient food systems (D'Odorico *et al.,* 2019).

Crucially, recent empirical work by Paul Jr. (2024) emphasises the growing significance of global agri-food value chains (GAVCs) in shaping food security and nutrition outcomes. Analysing trends between 1990 and 2020, Paul Jr. documents increased global participation in GAVCs, particularly in processed food products greater GAVC integration is positively associated with higher dietary energy consumption and reduced prevalence of undernourishment, especially in upper-middle-income countries.

In low-income countries, GAVC participation is most closely linked to reductions in child stunting, while the benefits in lower-middle-income countries are more mixed, including reductions in stunting alongside increases in both undernourishment and overweight prevalence. While integration into GAVCs can support improved food and nutrition security, its impacts are uneven and contingent on contextual factors such as income distribution, governance capacity, and local value chain competitiveness (Paul Jr., 2024).

Therefore, as global food systems evolve, enhancing participation in GAVCs must be accompanied by tailored policy measures. These include ensuring food safety standards, promoting technology transfer, and supporting the inclusion of smallholders and vulnerable populations in global value chains. Moreover, policy frameworks should be sensitive to the distributional consequences of trade integration – recognising that the benefits of globalisation have not accrued equally across or within countries.

## Trade balances, costs and trade regimes

Global agri-food trade is undergoing a significant rebalancing. This shift is shaped by structural changes in market demand, geopolitical tensions, environmental pressures, and disruptions to supply chains. Trade balances among major

agri-food economies reveal pronounced divergences, with the EU and Brazil strengthening their surplus positions, while the United States faces growing deficits. At the same time, China has emerged as a dominant importer, reshaping trade flows globally. These transformations underscore the strategic importance of trade balances not only as economic indicators but also as reflections of deeper competitiveness, trade cost structures, and regulatory choices (Godfray *et al.,* 2010; Savary *et al.,* 2022).

In 2024, the EU27 recorded agri-food exports totalling €235.4 billion and imports at €171.9 billion, producing a robust trade surplus of €63.5 billion. This surplus reflects sustained competitiveness supported by CAP reforms, food quality certification schemes, and trade agreements that provide extensive market access. Key export categories such as cereal preparations (€24.8 billion), dairy products (€19.7 billion), and wine-based products (€17.4 billion) highlight the EU's comparative advantage in high-value-added agri-food goods. Imports remain concentrated in off-season and tropical products, including coffee, tea, cocoa and spices (€30.3 billion, +47.5%), and fruit and nuts (€24.9 billion, +11.6%).

Brazil has emerged as another major surplus holder, with agri-food exports exceeding $100 billion in 2024 – a fivefold increase since 2010. Its expansion is largely commodity-driven, with soybeans, beef, poultry, and sugar leading exports. Brazil's success has been bolstered by increasing Asian demand – particularly from China – and its ability to maintain consistent exports during global shocks such as the COVID-19 pandemic and the Ukraine conflict (Piñeiro & Piñeiro, 2024). Its competitive advantage is reinforced by large-scale, low-cost production systems, logistics investment, and trade alignment strategies.

In contrast, the United States has experienced a decline in its agri-food trade position, recording a $3 billion deficit in 2022, down from a $40 billion surplus in 2010. This reversal stems from a surge in imports (around $200 billion) alongside stagnant export growth (approximately $197 billion), compounded by an overvalued U.S. dollar and the erosion of market share in China due to prior trade disputes (Awokuse *et al.,* 2024). A lack of new trade agreements and inconsistent policy initiatives have weakened U.S. agricultural competitiveness, while rising consumer demand for fresh and specialty products has increased dependency on imports.

China's transformation into a global agri-food importer – with imports exceeding $200 billion in 2024 – has shifted the gravitational centre of global trade. Its import structure prioritises soybeans, dairy, meat, and fruit, and the country has aggressively diversified suppliers following trade tensions with the U.S., strengthening ties with Brazil, Argentina, and the EU (Afesorgbor *et al.,* 2024b). China's role as both a trade partner and strategic actor further complicates the agri-food landscape, as supplier competition intensifies.

These evolving trade balances must be interpreted through the lens of trade costs, which remain critical in shaping agri-food flows. As noted by Beghin and Schweizer (2021), transportation costs, border tariffs, and non-tariff measures (NTMs) continue to dominate the cost structure of agricultural trade. Agricultural products tend to be bulky, perishable, and of low value-to-weight ratio, making them particularly sensitive to such costs (Fiankor and Santeramo, 2023). Despite their importance, transportation costs are often poorly captured in empirical studies due to their heterogeneity across commodities, routes, and time. Beghin and Schweizer (2021) argue that improving data and methods to capture these dynamics – beyond simplistic distance proxies – could generate more accurate cost models and better policy insights. They emphasise that liberalising transportation services could significantly lower trade barriers and improve supply chain resilience.

Tariff levels, meanwhile, have declined dramatically over recent decades and are expected to remain low, apart from isolated protectionist episodes like the Trump administration's unilateral measures. However, NTMs have grown in prominence and complexity, representing the most difficult trade costs to quantify and regulate. According to Beghin and Schweizer (2021), NTMs – particularly standard-like measures such as Sanitary and Phytosanitary (SPS) regulations and Technical Barriers to Trade (TBTs) – pose challenges in terms of transparency, aggregation, and policy evaluation. The authors call for enhanced detection of protectionist motives and recommend policy frameworks that encourage transparency and risk-based regulation.

The empirical literature supports this view but also reveals a high degree of heterogeneity in the effects of NTMs. A meta-analysis by Santeramo and Lamonaca (2019) shows that NTMs can act either as barriers or catalysts, depending on the type of measure, the proxies used to quantify them, and the granularity of the data. Their study found that Maximum Residue Limits (MRLs) and ad valorem equivalents (AVEs) often facilitate trade, while other NTMs – such as some SPS and TBT regulations – can restrict it. Moreover, the level of disaggregation in studies, and the methodological choices made (such as controlling for multilateral resistance or zero trade flows), significantly influence the results.

Santeramo and Lamonaca (2019) conclude that no generalisable effect of NTMs can be asserted. Instead, outcomes vary by product, country, and institutional capacity. This aligns with the broader literature suggesting that NTMs reflect a complex balance between legitimate consumer protection and disguised protectionism (Larch *et al.,* 2024). Policymakers are therefore encouraged to focus on institutional capacity building and evidence-based regulatory design that minimises trade distortion while upholding safety and sustainability standards.

In summary, the rebalancing of global agri-food trade reflects not only shifts in demand and supply but also the evolving nature of trade costs and governance. The EU and Brazil have enhanced their trade positions through diversified, competitive, and policy-aligned export strategies. Conversely, the United States' declining trade surplus points to structural weaknesses in its trade policy and regulatory alignment. Trade costs – especially transportation and NTMs – remain central to explaining these trends. As Beghin and Schweizer (2021) and Santeramo and Lamonaca (2019) demonstrate, a nuanced understanding of these costs is essential for crafting effective agricultural trade policy in a highly interconnected and increasingly volatile global environment.

## Geopolitical tensions

Rising geopolitical tensions and increasing economic fragmentation are exerting profound and multifaceted effects on global food security. As states respond to international competition and conflict by erecting trade barriers, imposing tariffs, and enacting economic sanctions, they disrupt established supply chains and fuel volatility in global agri-food markets. These disruptions are particularly acute in countries of the Global South, where heavy reliance on food imports, limited production capacities, and constrained fiscal space render populations highly vulnerable to price shocks and supply interruptions (Afesorgbor *et al.,* 2024b).

Among the most frequently deployed instruments in this evolving geopolitical landscape are trade restrictions – particularly export and import bans on critical agricultural commodities. These measures, intended to shield domestic markets or apply strategic pressure, have been observed in at least 72 documented instances in recent years. At the same time, economic sanctions have become widespread tools of political leverage, frequently resulting in significant reductions in bilateral trade volumes. In some cases, comprehensive sanctions have reduced agricultural trade flows by as much as 70%, with devastating implications for the availability and affordability of food in targeted regions (Bosone *et al.,* 2024).

Emerging empirical evidence underscores that the consequences of economic sanctions extend beyond trade disruption. Sanctions are strongly correlated with rising food prices, increased undernourishment, and worsening food insecurity in affected countries. These effects are particularly damaging in low-income and import-dependent economies, where even modest price increases can have disproportionate effects on household food access. As Afesorgbor *et al.* (2024b) observe, sanctions not only impede market functioning but also intensify humanitarian crises, raising ethical questions about their design and deployment in a world increasingly interlinked by agri-food trade.

At the institutional level, the entrenchment of food insecurity within trade policy frameworks has exposed the limits of existing multilateral mechanisms. As Margulis (2014) argues, the World Trade Organization (WTO) has become both a site of contestation and a geopolitical actor in its own right within the global agro-food system. The 2007–2008 Global Food Crisis, in particular, catalysed a re-legitimisation of the WTO as a relevant stakeholder in food security governance. Despite its institutional paralysis, the WTO became increasingly integrated into global policymaking networks such as the High-Level Task Force on Global Food Security and inter-agency coordination mechanisms.

However, this institutional prominence has done little to resolve growing tensions between established agro-powers and emerging ones. As Margulis (2014) notes, recent WTO negotiations around export restrictions, public stockholding, and the Special Safeguard Mechanism (SSM) have revealed deep fractures between Net Food Exporters (NFEs) and Net Food Importers (NFIs). The failure to secure exemptions for vulnerable food-importing countries in multilateral trade rules – particularly regarding food export restrictions – illustrates how power asymmetries in global trade are being reconfigured but not necessarily ameliorated. In fact, the transition towards a polycentric agro-food system may be reproducing conditions that are less favourable for the world's most food-insecure populations.

The case of trade restrictions during geopolitical crises reinforces this point. Measures justified as necessary for domestic stability often translate into external vulnerabilities, exacerbating scarcity and price volatility for low-income countries (Kornher *et al.*, 2024). Margulis (2014) emphasises that food export restrictions have become a focal point in WTO negotiations, as agro-powers seek to preserve policy space while simultaneously shaping global norms. This dynamic complicates traditional North–South framings, highlighting instead a spectrum of conflicts that includes intra-South disagreements and emerging alignments among new agro-powers. These shifts necessitate a more nuanced geopolitical lens that accounts for the evolving architecture of influence within global food systems.

Considering these transformations, there is an urgent need to explicitly embed food security considerations within the design of trade and foreign policy instruments. While trade restrictions and sanctions may be intended as political tools to exert pressure on states, they often produce unintended humanitarian consequences for civilian populations (Rodríguez, 2024). Incorporating food security safeguards – such as exemptions for basic staples, humanitarian carve-outs, and transparency requirements – can help mitigate the adverse effects of these instruments on vulnerable groups.

Furthermore, institutional reforms at the multilateral level, particularly within the WTO, must address the increasingly visible disconnect between trade governance and global food needs. As Margulis (2014) observes, geopolitical struggles over WTO rules have not diminished but intensified, particularly as NFEs and NFIs seek to reshape the rules governing agri-food markets. Recognising food security as a central dimension of trade policy is not merely a normative imperative but a strategic necessity in an era marked by supply chain fragility, climate risk, and intensifying geopolitical competition.

In sum, the intersection of trade policy and food security is no longer a marginal issue. As geopolitical tensions rise, the tools used to navigate global conflicts – sanctions, tariffs, and export bans – must be reassessed for their humanitarian implications. Trade governance institutions must adapt to the realities of a more polycentric and contested agro-food system, where the stakes of food security are higher than ever and the power to shape its future is more widely distributed but not evenly shared.

## Environmental Rules and Agri-Food Trade

Integrating climate-resilient agricultural practices is essential for sustaining food production in the face of accelerating environmental pressures. Precision agriculture, artificial intelligence–driven crop management systems, and other

climate-smart farming approaches offer pathways to improve yields, increase water-use efficiency, and reduce input waste. These strategies not only enhance productivity but also support long-term food security and nutritional outcomes, especially under conditions of increasing climatic variability. A holistic approach to sustainability in agri-food trade must therefore bridge ecological resilience with socioeconomic equity – promoting biodiversity conservation, efficient resource management, and inclusive development.

However, the expanding use of technical regulations aimed at environmental protection introduces new complexities to the global agri-food trade landscape. Environmental technical measures (ETMs) – including regulations on emissions, input standards, and sustainable sourcing – are now more prevalent and less transparent than traditional tariffs (Santeramo *et al.,* 2025). Although these measures are designed to serve vital non-trade objectives, their indirect effects on trade flows are increasingly evident. Recent evidence suggests that such environmental policies can substantially reduce both trade volumes and values, particularly in developing countries, where compliance infrastructure is less robust. The risk is that these regulations, while well-intentioned, may inadvertently act as technical barriers to trade (TBTs), especially when implemented unilaterally or without adequate transparency.

Lamonaca and Santeramo (2025) further elaborate on this point, applying advanced gravity modelling techniques to national-level trade flow data. Their study confirms that ETMs often increase compliance costs and introduce uncertainty into trade relationships, ultimately discouraging market participation. This dynamic can disproportionately affect exporters in the Global South, reinforcing structural inequalities in agri-food markets. As the international community moves toward more ambitious environmental targets, it is crucial to balance these goals with mechanisms that ensure equitable access to global markets and reduce the unintended exclusion of environmentally vulnerable economies.

This concern is echoed in the broader literature on the environmental impacts of agri-food trade. A systematic review by Balogh and Jámbor (2020) finds that most empirical studies associate agricultural trade with increased environmental externalities – including deforestation, biodiversity loss, soil erosion, and greenhouse gas (GHG) emissions. Their analysis, covering over 65 peer-reviewed articles, shows that agricultural trade frequently accelerates resource-intensive production practices and relocates pollution from developed to developing countries. Notably, trade liberalisation has often contributed to land-use change in regions such as Brazil and Southeast Asia, driven by demand for export crops like soy, palm oil, and beef. Although some studies note positive effects – such as technology transfer and efficiency gains – the predominant finding is that agricultural trade tends to intensify environmental degradation unless strong regulatory frameworks are in place.

The environmental footprint of agri-food trade is further underscored in the comprehensive review by Baylis *et al.* (2021), who highlight the growing spatial reallocation of agricultural production in response to liberalied trade. According to their findings, global agricultural trade has expanded more rapidly than production itself since 2000, with Latin America and Eastern Europe increasing their export shares, while Asia and Africa have grown as net importers. This shift, while improving market access and food availability in many regions, has raised concerns about the sustainability of production at new frontiers. Agriculture already consumes 70% of global freshwater resources and occupies 40% of terrestrial land (OECD–FAO, 2025); trade-induced changes to production locations exacerbate pressures on these natural systems.

Baylis *et al.* (2021) also point to a critical theoretical insight: the environmental impact of trade depends not solely on trade flows, but on domestic environmental policy quality. In regions with weak property rights or ineffective enforcement, trade can exacerbate negative externalities. By contrast, if trade occurs alongside robust environmental governance, it may incentivise sustainable production and promote more efficient use of natural resources. The paper further emphasises the potential of private sustainability initiatives – such as eco-labelling and certified supply chains – to support environmental outcomes, although the empirical evidence for their effectiveness remains limited and highly context-specific. Importantly, both ecological and economic disciplines agree on the need for international coordination to address these challenges and align trade and environmental goals.

Given these dynamics, understanding the trade-offs and spillover effects of environmental regulations is vital to crafting coherent and equitable trade policy. While environmental technical measures are essential for achieving sustainability objectives, they must be designed to minimise distortive effects and ensure compatibility with multilateral trade norms. Mechanisms such as transparency obligations under the WTO, capacity-building for compliance in developing countries, and differentiated implementation timelines could help reconcile environmental ambitions with inclusive trade participation.

In this context, future research must address the dual challenge of environmental integrity and market efficiency. As highlighted by Santeramo *et al.* (2025) and Lamonaca and Santeramo (2025), methodological innovations in measuring the trade effects of ETMs will be key to improving policy diagnostics. Additionally, the work of Baylis *et al.* (2021) and Balogh and Jámbor (2020) underscores the importance of integrated, interdisciplinary analysis – bringing together environmental science, economics, and political ecology – to capture the full spectrum of environmental outcomes linked to agri-food trade.

In conclusion, promoting sustainability in global agri-food trade requires not only investments in climate-smart agriculture and resource efficiency but also institutional innovations that can manage the intersection between trade regulation and environmental protection. Without careful design, the tools intended to protect the planet may inadvertently constrain those most in need of access to global food markets. Achieving a balance between environmental goals and trade equity will demand more than technical fixes – it will require a shared global commitment to inclusive, transparent, and ecologically responsible trade governance.

## Concluding remarks

The evolving landscape of agri-food trade is deeply shaped by historical legacies, geopolitical dynamics, and environmental challenges, all of which interact to influence global food security. While agricultural production is set to increase, the distribution of benefits will be uneven, with emerging markets gaining export share and intensifying competition. Rising geopolitical tensions have led to fragmented trade policies, including sanctions and trade barriers, which disrupt supply chains and disproportionately threaten food security in vulnerable, import-dependent countries. At the same time, the growing complexity of trade agreements reflects both economic and strategic considerations, where regulatory cooperation can facilitate trade but overlapping standards may increase compliance costs. Moreover, the increasing prevalence of environmental technical measures adds another layer of complexity, as efforts to promote sustainability risk imposing trade restrictions that could hinder market access and resilience. To navigate these intertwined challenges, coordinated investments in climate-smart agriculture, infrastructure, and strategic trade engagement are essential. Policymakers must balance environmental objectives with the need for efficient and inclusive trade systems to ensure stable and equitable food supplies worldwide. Ultimately, fostering a resilient, nutrition-sensitive, and sustainable global food system requires holistic approaches that integrate geopolitical realities, technological innovation, and environmental stewardship to meet the demands of a growing and changing global population.

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