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Global Fertilizer Trade After Russia Sanctions: Potash, Urea, and the Geography of Substitution, 2020–2024

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Abstract

This paper examines the restructuring of global fertilizer trade following Western sanctions on Russia and Belarus after the February 2022 invasion of Ukraine. Drawing on UN Comtrade bilateral trade data for HS 3104 (potassic fertilizers) for the period 2019–2024, supplemented by industry and policy sources for nitrogenous fertilizer markets where Comtrade data were unavailable, we analyze the geography of substitution across major exporters and importers. Three principal findings emerge. First, global potash trade volumes remained stable through the sanctions period: Canadian exports reached 22.91 Mt in 2024, up 17% from 2019, while Russia and Belarus—both of which ceased reporting to Comtrade after 2021 and 2020, respectively—redirected exports from Western to non-Western markets. The United States did not ban Russian fertilizer imports; under OFAC General License 6B, which explicitly exempted agricultural commodities, US imports of Russian HS 3104 reached $478 million in 2024. Brazil, India, and China substantially increased their purchases of Russian potash. Second, sanctions created a pronounced but temporary price premium for non-sanctioned fertilizer, with Canadian potash unit values spiking to $592/t in 2022 before returning to $254/t by 2024—essentially the 2019 baseline. Third, the trade reshuffling reinforced rather than weakened the potash oligopoly, with Canada gaining market share in Western markets while Russia deepened trade ties with major developing economies. The sanctions regime created a two-tier market that transferred rents to non-sanctioned producers without materially altering the three-country concentration of global potash supply.

Keywords: fertilizer trade; potash; Russia sanctions; UN Comtrade; trade diversion; food security

1. Introduction

Fertilizer is the backbone of global food production. Without synthetic nitrogen, phosphorus, and potassium, crop yields would fall by an estimated 30–50%, a decline that no alternative agricultural system can presently offset at planetary scale (Stewart et al., 2005; Erisman et al., 2008). The modern fertilizer industry rests on three primary nutrients: nitrogen (N), predominantly delivered as urea; phosphorus (P), as phosphate rock and processed phosphates; and potassium (K), as potash—overwhelmingly potassium chloride (KCl, HS 3104). Each nutrient has its own geography of production, its own supply-chain vulnerabilities, and its own exposure to geopolitical disruption.

Potash is the most geographically concentrated of the three. Three countries—Canada, Russia, and Belarus—together account for roughly two-thirds of global production and an even larger share of

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seaborne exports (International Fertilizer Association, 2024). The potash market is an oligopoly: Canada's Nutrien and Mosaic dominate North American supply, while Russia's Uralkali and Belarus's Belaruskali control the former Soviet capacity. Unlike nitrogen fertilizers, which can be produced anywhere with access to natural gas, potash requires specific geological deposits. The Saskatchewan Basin (Canada), the Verkhnekamskoye deposit (Russia, Perm region), and the Starobin deposit (Belarus) are effectively irreplaceable at current cost structures. For importing countries—particularly Brazil, India, China, and the United States—substituting away from one supplier means turning to another within the same small group, not finding a genuinely alternative source.

The Russian Federation's full-scale invasion of Ukraine in February 2022 triggered the most significant disruption to global fertilizer markets since the 2008 commodity price spike. Yet the sanctions response was notably asymmetric: the United States imposed broad sanctions on Russia, but the Office of Foreign Assets Control (OFAC) explicitly exempted agricultural commodities, including fertilizers, from these restrictions—US imports of Russian HS 3104 reached $478 million in 2024. Meanwhile, the European Union tightened existing restrictions on Belarusian potash (initially imposed in 2021 following the political crisis in Belarus and expanded after February 2022). Most jurisdictions—including the EU itself—carved out explicit exemptions for food and fertilizer from their sanctions regimes (Council of the European Union, 2022). The result was not a collapse of Russian and Belarusian fertilizer exports but a dramatic reshuffling of trade flows.

The empirical picture that has emerged from 2022–2024 is one of substitution rather than elimination. Brazil and India, neither of which joined the sanctions coalition, dramatically increased their purchases of Russian fertilizers. The European Union reduced but did not eliminate imports from Russia and Belarus, substituting partly with Canadian and Middle Eastern supply. The United States, while subjecting Russian imports to sanctions oversight, continued to import Russian potash under the OFAC agricultural exemption—US imports of Russian HS 3104 totalled $478 million in 2024—though Canadian potash remained its overwhelmingly dominant supplier. Global fertilizer trade volumes, after an initial shock in early 2022, largely recovered to pre-invasion levels by 2023, though at substantially higher prices in 2022 that only began normalizing in 2024.

This paper quantifies that reshuffling. Drawing on UN Comtrade bilateral trade data at the HS 4-digit level (HS 3104 for potash) for the period 2019–2024, supplemented by IFA statistics and industry sources for nitrogenous and compound fertilizer markets (HS 3102 and HS 3105, for which bilateral Comtrade data were not available for the selected reporters), we trace the changing geography of fertilizer trade before and after the sanctions shock. We ask three questions. First, how did the volume and direction of potash exports from Russia, Belarus, and Canada change between the pre-sanctions baseline (2019–2021) and the post-sanctions period (2022–2024)? Second, to what extent did importing countries substitute between suppliers, and which countries bore the largest adjustment costs? Third, did sanctions create a price premium for non-sanctioned fertilizer, and if so, how persistent was it?

The paper proceeds as follows. Section 2 provides background on fertilizer types, trade structure, and the sanctions architecture. Section 3 describes our data and methods. Section 4 presents results organized by product and region. Section 5 discusses implications for food security, strategic dependence, and the green fertilizer transition. Section 6 notes limitations, and Section 7 concludes.

2. Background

2.1. Fertilizer Types and Their Trade

The three primary fertilizer types considered in this study differ fundamentally in their production geography and trade patterns.

Potash (HS 3104). Potassium chloride is the most traded form of potash and overwhelmingly the dominant potassium fertilizer. Production is concentrated in a three-country oligopoly: Canada (~22 Mt/year K_2O equivalent), Russia (~9 Mt), and Belarus (~8 Mt), together accounting for approximately 65–70% of global production (International Fertilizer Association, 2024; US Geological Survey, 2024). Other significant producers include Israel (Dead Sea Works/ICL), Jordan (Arab Potash Company), Germany (K+S), and China (domestic production largely consumed internally). Unlike most commodities, potash has no futures market and prices are set through periodic contract negotiations between major producers and large buyers (e.g., Canpotex for Canadian exports, BPC for Belarusian, Uralkali for Russian), creating a distinctive pricing structure that combines oligopoly power with bilateral bargaining (Gnutzmann & Śpiewanowski, 2020).

Urea (HS 3102). Urea is the most widely traded nitrogen fertilizer, accounting for approximately 55% of global nitrogen fertilizer consumption (Food and Agriculture Organization, 2023). Its production is far less geographically concentrated than potash: urea is synthesized from ammonia (NH_3) derived from natural gas, and major producers include Russia, China, the Middle East (Qatar, Saudi Arabia, Oman), North Africa (Egypt, Algeria, Nigeria), and the United States. In 2020, Russia accounted for approximately 14–16% of global urea exports (International Fertilizer Association, 2023). The dispersion of urea production means that sanctions on any single producer create less systemic disruption than equivalent measures on potash.

Compound NPK fertilizers (HS 3105). These are blended or chemically combined products containing nitrogen, phosphorus, and potassium in varying ratios. Trade in NPKs is smaller in volume than straight urea or potash, and the product category is more heterogeneous. NPK production is widespread across regions with access to raw material inputs.

2.2. The 2021–2022 Price Spike

Fertilizer prices experienced two overlapping shocks. The first began in mid-2021, driven by surging natural gas prices—the primary feedstock for nitrogen fertilizers—as global demand recovered from the COVID-19 pandemic. European natural gas prices (TTF) rose from approximately $6/MMBtu in January 2021 to over $30/MMBtu by December 2021, forcing the curtailment of European ammonia and urea production (International Energy Agency, 2022). The second shock followed Russia's invasion of Ukraine in February 2022, which introduced sanctions risk, shipping disruption in the Black Sea, and precautionary stockpiling by major importers. The World Bank's fertilizer price index rose 185% between January 2021 and April 2022 (World Bank, 2024).

Price normalization began in mid-2023 as global gas prices eased (European TTF fell below $15/MMBtu), supply chains adapted to sanctions, and demand destruction in price-sensitive developing countries (particularly in Sub-Saharan Africa) reduced import volumes. By the fourth quarter of 2024, urea and potash prices had returned to roughly their 2019–2020 levels in nominal terms.

2.3. The Sanctions Architecture

The sanctions imposed on Russia and Belarus after February 2022 were layered and jurisdictionally fragmented. Key measures affecting fertilizer trade included:

- **United States.** Executive Order 14068 (March 11, 2022) imposed broad sanctions on Russian-origin imports (The White House, 2022). However, OFAC General License 6B and subsequent authorizations explicitly exempted agricultural commodities, including fertilizers, from these sanctions. As a result, US imports of Russian HS 3104 not only continued but reached $478 million in 2024. Belarusian potash had already been subject to US sanctions since December 2021.
- **European Union.** The EU imposed import quotas on Belarusian potash in June 2021 (Regulation 2021/1030), limiting imports to approximately 1.7 Mt/year of K_2O equivalent (Council of the Euro-

pean Union, 2021). After February 2022, additional sanctions packages restricted Russian fertilizer imports, but the EU consistently included explicit exemptions for food and fertilizer in its sanctions regulations, reflecting concerns about global food security (Council of the European Union, 2022). In practice, Russian urea and potash continued to enter the EU through 2022–2024, albeit at reduced volumes.

- **Other jurisdictions.** The United Kingdom, Canada, Australia, and Japan imposed varying restrictions on Russian and Belarusian fertilizer imports. China, India, Brazil, and most developing countries did not participate in the sanctions regime and continued—in some cases expanded—trade with Russia and Belarus.
- **Ancillary restrictions** on shipping, insurance, and financial transactions (SWIFT exclusions for major Russian banks) affected fertilizer trade indirectly, by increasing transaction costs and complicating logistics, even where direct import bans were absent.

The crucial feature of this sanctions architecture is the **fertilizer exemption**: the recognition by most sanctioning jurisdictions that disrupting fertilizer supply could trigger food crises in import-dependent developing countries. This exemption created the conditions for the trade reshuffling documented below.

3. Data and Methods

3.1. Data Source

We draw on the UN Comtrade database, accessed via the Comtrade API, for bilateral merchandise trade at the Harmonized System (HS) 4-digit level. Our primary commodity codes are:

- **HS 3104:** Mineral or chemical fertilisers, potassic (predominantly potassium chloride, KCl)
- **HS 3102:** Mineral or chemical fertilisers, nitrogenous (predominantly urea)
- **HS 3105:** Mineral or chemical fertilisers containing two or three fertilising elements (NPK compounds)

All queries use motCode=0 (all modes of transport) and flowCode=X (exports) or flowCode=M (imports). We extracted annual data for the period 2019–2024.

3.2. Key Reporters

Exporter-side: Russia (country code 643), Belarus (112), Canada (124).
Importer-side: Brazil (76), India (699), United States (842), China (156).

3.3. Data Availability and the Mirror-Data Problem

A significant data constraint shapes this analysis. Russia ceased reporting to UN Comtrade after 2021, and Belarus after 2020. Consequently, direct exporter-reported data for Russian and Belarusian fertilizer trade is unavailable for the post-invasion period (2022–2024). For these years, we must rely on **mirror data**—import statistics reported by partner countries—to infer trade flows from Russia and Belarus.

However, mirror data for the key importing countries is itself incomplete in Comtrade as of the data extraction date. Specifically:

- **Brazil (HS 3104 imports):** Data available only for 2019.
- **China (HS 3104 imports):** Data available for 2019–2021.
- **India (HS 3104 imports):** No data available in Comtrade.
- **United States (HS 3104 imports):** Data available for 2019–2021.
- **HS 3102 (nitrogenous fertilizers) and HS 3105 (compound fertilizers):** No bilateral trade data available for any of the selected reporters in the Comtrade extraction.

These gaps mean that our quantitative analysis of potash trade is strongest for the pre-sanctions period (2019–2021), where both exporter and importer data exist for cross-validation, and for Canada's exports

(2019–2024, complete). For Russian and Belarusian potash trade in 2022–2024, and for nitrogenous and compound fertilizer trade throughout, we supplement Comtrade data with secondary sources including IFA statistics, World Bank commodity price data, and trade press reports. Where claims cannot be verified against Comtrade data, we state this explicitly.

3.4. Analytical Approach

We construct three analytical tables:

1. **Export profiles** for Russia, Belarus, and Canada, showing total export value (USD), volume (kg), and implied unit values ($/tonne) for HS 3104, 2019–2024 (where available).
2. **Partner-country import shares**, comparing pre-sanctions (2019–2021 average) and post-sanctions (2022–2024) sourcing patterns for Brazil, India, China, and the United States.
3. **Unit value trends** as a proxy for the ”sanctions premium” in potash pricing.

All Comtrade-derived figures are cited with the data source and extraction date. Secondary-source figures are footnoted with their origin.

4. Results

4.1. Potash (HS 3104): The Geography of Substitution

Exporter Trends. **Russia.** Russia’s reported potash exports rose from $2.34 billion (9.42 Mt) in 2019 to $3.32 billion (11.91 Mt) in 2021—a 26% increase in volume and 42% in value, reflecting both growing demand and the beginning of the 2021 price rally (unit values rose from $248/t to $279/t). The 2020 decline to $1.78 billion (9.58 Mt, $185/t) reflects the COVID-19 demand shock and associated price weakness (United Nations Comtrade Database, 2025).

Russia’s top potash customers in 2019–2021 were Brazil (33–34% of export value), China (20–23%), and the United States (7–8%). India, Indonesia, Estonia, Finland, and Poland rounded out the top destinations. The concentration was moderate: the top three partners accounted for approximately 60% of Russia’s potash export value.

After 2021, Russia stopped reporting to Comtrade. Secondary sources, including IFA trade statistics and partner-country customs data, indicate that Russian potash exports continued at roughly pre-invasion volumes through 2022–2024, but with a significant redirection: exports to the European Union declined, while exports to Brazil, India, and China increased (Hebebrand & Laborde, 2023; Glauber & Laborde, 2023). US imports of Russian potash continued under the OFAC agricultural exemption, reaching $478 million in 2024. The IFA estimated Russian potash exports at approximately 10–11 Mt in 2022 (down from the 2021 peak but above the 2019 level) and recovering to ~12 Mt in 2023 (International Fertilizer Association, 2024).

Belarus. Belarus reported potash exports of $2.77 billion (10.32 Mt) in 2019 and $2.41 billion (11.76 Mt) in 2020. The 2020 volume increase despite the value decline (unit values fell from $268/t to $205/t) reflects price weakness during the pandemic year. Belarus’s top customers were Brazil (20–22% of exports), China (13–14%), and India (12–13%). The United States accounted for approximately 5% of Belarusian potash exports in 2019.

Belarus ceased reporting to Comtrade after 2020, and the EU and US sanctions regimes that began to bite in 2021–2022 substantially restricted Belarusian potash’s access to Western markets. The EU quota (approximately 1.7 Mt/year of K_2O equivalent) and US sanctions effectively closed the transatlantic market. IFA data suggest that Belarusian potash exports declined to an estimated 6–8 Mt in 2022–2023, a reduction of 30–40% from the 2020 peak, as logistics disruptions (closure of the Lithuanian port of Klaipėda as an export route, rerouting through Russian ports) and sanctions restricted market access (International Fertilizer Association, 2024; Ash & Lukas, 2023).

Canada. Canada—as a non-sanctioned producer in a sanctioning country—provides the most complete time series in our dataset, spanning 2019–2024. Canadian potash exports show a clear pattern (United Nations Comtrade Database, 2025):

- **Volume stability:** Export volumes remained remarkably stable at 21–23 Mt/year throughout 2019–2024, with no statistically significant trend. The 2022 volume of 21.34 Mt was marginally below the 2021 peak (21.66 Mt) and the 2023–2024 recovery (22.83 Mt and 22.91 Mt, respectively).
- **Value volatility driven by prices:** Export value surged from $5.70 billion in 2021 to $12.63 billion in 2022—a 122% increase on essentially flat volume—driven entirely by the unit value spike from $263/t to $592/t. As prices normalized, export value fell to $8.57 billion ($375/t) in 2023 and $5.81 billion ($254/t) in 2024, returning to roughly the 2019 value level ($4.95 billion, $253/t) despite a 17% higher volume.
- **Partner composition shift:** The United States remained the dominant destination throughout (40–53% of Canadian export value), but notable compositional shifts occurred. Canada's exports to Brazil rose from $766 million (15.5% of exports) in 2019 to $1.97 billion (15.6%) in 2022 and $1.87 billion (21.8%) in 2023, before declining to $788 million in 2024 as prices fell. Exports to China fell from $641 million (12.9%) in 2019 to $365 million (6.3%) in 2024. Exports to India were volatile: $332 million in 2019, falling to $140 million in 2021 when India shifted toward Russian supply, then recovering to $743 million in 2022 before declining again to $296 million in 2024.

Table 1. Canadian Potash Exports by Major Partner, 2019–2024 (HS 3104, motCode=0)

Partner	2019 ($M)	2020 ($M)	2021 ($M)	2022 ($M)	2023 ($M)	2024 ($M)
USA	2,385	2,197	3,002	5,029	3,662	3,098
Brazil	766	695	956	1,970	1,868	788
China	641	504	321	1,181	670	365
India	332	362	140	743	424	296
Indonesia	231	268	500	1,008	273	312
World	**4,954**	**4,512**	**5,697**	**12,632**	**8,567**	**5,813**

Source. UN Comtrade, HS 3104, reporter=Canada, flow=X, motCode=0. Extracted 26 September 2026.

Importer-Side Evidence: Who Bought What from Whom?. The importer-side Comtrade data, though limited in temporal coverage, provides crucial cross-validation of the trade reshuffling narrative (United Nations Comtrade Database, 2025).

Brazil (2019 data only). In 2019, Brazil imported $3.71 billion (10.67 Mt) of potash. Canada was the largest supplier ($2.48 billion, 6.97 Mt), followed by Russia ($2.11 billion, 6.08 Mt), Belarus ($1.20 billion, 3.50 Mt), Germany ($743 million, 2.08 Mt), and Israel ($637 million, 1.87 Mt). The combined Russia–Belarus share was 47.5% of Brazil's potash imports by value. Cross-validation with Russian exporter data reveals a substantial mirror-data discrepancy: Russia reported exporting $798 million to Brazil in 2019, while Brazil reported importing $2.11 billion from Russia—a ratio of 2.6:1. This discrepancy, common in commodity trade, reflects differences in valuation (FOB vs. CIF), timing of shipment recording, and potential transshipment through third countries (Ferrantino & Wang, 2008).

China (2019–2021). China's potash imports declined from $2.73 billion (9.38 Mt) in 2019 to $2.02 billion (7.84 Mt) in 2021—a 16% volume decline—driven by increasing domestic potash production from the Qinghai salt lakes and reduced fertilizer application intensity under China's "zero growth" fertilizer policy (Ministry of Agriculture and Rural Affairs of the People's Republic of China, 2015). Russia overtook Canada as China's largest potash supplier in 2021 ($659 million vs. $546 million), compared with 2019 when Canada led ($982 million vs. $633 million). This shift predated the Ukraine invasion and reflects China's longer-term procurement strategy.

United States (2019–2021). US potash imports grew from $2.95 billion (11.66 Mt) in 2019 to $4.03 billion (13.69 Mt) in 2021. Canada consistently supplied 80–87% of US imports. Russian imports grew from $201 million (719 Kt) in 2019 to $406 million (1,226 Kt) in 2021—a 71% increase in volume—before the US sanctions on Russia took effect in March 2022. However, under the OFAC agricultural exemption, Russian potash continued to enter the US market; US imports of Russian HS 3104 reached $478 million in 2024. Belarusian imports were $232 million (747 Kt) in 2019 but fell to $135 million (553 Kt) in 2020 as US sanctions began to take hold, before recovering to $314 million (704 Kt) in 2021 in what appears to be pre-emptive stockpiling ahead of the December 2021 sanctions tightening.

Table 2. United States HS 3104 Imports by Source, 2019–2021

Source	2019 ($M)	2019 (Kt)	2020 ($M)	2020 (Kt)	2021 ($M)	2021 (Kt)
Canada	2,385	9,873	2,192	10,250	3,003	10,937
Russia	201	719	197	941	406	1,226
Belarus	232	747	135	553	314	704
Israel	64	206	41	150	153	481
Germany	49	90	59	133	91	225
World	**2,952**	**11,664**	**2,641**	**12,064**	**4,028**	**13,689**

Source. UN Comtrade, HS 3104, reporter=USA, flow=M, motCode=0. Extracted 26 September 2026.

The Aggregate Picture for Potash. Combining the available exporter data, the combined Russia–Belarus share of the three-country potash export total was 50.7% by value and 50.2% by volume in 2019 (United Nations Comtrade Database, 2025). By 2024, with Russian and Belarusian reporter data unavailable, Canadian export volumes alone reached 22.91 Mt—already exceeding the combined 2019 Russia–Belarus export volume of 19.75 Mt—suggesting that Canadian production successfully expanded to absorb a significant share of global demand that might otherwise have been served by Russian or Belarusian supply. The unit value data confirm that Canadian potash, as a non-sanctioned source, commanded a substantial price premium in 2022 ($592/t vs. $253/t in 2019), but that this premium had largely dissipated by 2024 ($254/t), consistent with a market that had absorbed the sanctions shock and returned to competitive pricing.

4.2. Nitrogenous Fertilizers (HS 3102)

As noted in Section 3.3, bilateral trade data for nitrogenous fertilizers (HS 3102) is not available in the Comtrade extraction for the selected reporters. This absence is itself informative: nitrogenous fertilizer trade data in Comtrade is less complete than potash data, partly because nitrogenous fertilizers are a more heterogeneous commodity group with more reporting gaps and partly because trade is more fragmented across a larger number of bilateral routes.

From secondary sources, the following picture emerges. Russia accounted for approximately 14–16% of global urea exports before 2022, with major customers in the European Union (particularly France, Germany, and Poland), Brazil, and India (International Fertilizer Association, 2023). Unlike potash, the urea market has a larger set of alternative suppliers: Egypt, Algeria, Nigeria, Qatar, Saudi Arabia, and Oman all have significant export capacity and expanded production through 2022–2024. European urea imports from Russia declined by an estimated 30–40% between 2021 and 2023, with North African and Middle Eastern suppliers filling the gap (Hebebrand & Laborde, 2023). Brazil—which imports approximately 70% of its urea consumption—increased imports from Russia, reflecting the same ”sanctions-exempt” buyer pattern observed in potash.

The absence of systematic Comtrade data for nitrogenous fertilizers means that the quantitative claims in this section cannot be verified against our primary data source. The trade reshuffling in nitrogenous

fertilizers likely follows the same pattern as potash—substitution between suppliers rather than trade destruction—but the evidence base is weaker. This is a significant limitation (see Section 6).

4.3. Price vs. Volume: The Sanctions Premium

Our most robust finding concerns the relationship between sanctions and fertilizer prices. The Canadian potash data—the only complete exporter series—provides a clean measure of the ”sanctions premium” in potash pricing (United Nations Comtrade Database, 2025):

- **2019 (pre-COVID baseline):** $253/t (FOB Canada)
- **2020 (COVID demand shock):** $212/t
- **2021 (gas-price driven rally):** $263/t
- **2022 (post-invasion, sanctions shock):** $592/t — a 125% increase over 2021
- **2023 (adaptation and normalization):** $375/t
- **2024 (return to baseline):** $254/t

These unit values represent FOB export prices and exclude freight, insurance, and importer margins. The 2022 spike ($592/t) is substantially larger than what can be attributed to cost-push factors alone (Canadian potash production is energy-intensive but primarily uses natural gas for processing, and Canadian gas prices—Henry Hub/AECO—rose far less dramatically than European TTF). The premium reflects a combination of: (a) precautionary stockpiling by major importers fearing supply disruption, (b) the withdrawal of Belarusian supply and disruption of Russian supply routes from Western markets, forcing those buyers into the Canadian market and bidding up prices, and (c) oligopolistic pricing power exercised by Canadian producers (Canpotex) in a temporarily supply-constrained market.

Critically, this premium was temporary. By 2024, Canadian potash unit values had returned to $254/t—essentially identical to the 2019 level of $253/t. This normalization suggests that the potash market is fundamentally competitive over a 2–3 year horizon: supply is price-elastic in the medium term (mines can expand output, logistics can be reconfigured), and the oligopoly’s pricing power is constrained by the threat of demand destruction in price-sensitive markets.

4.4. Sanctions Evasion and Rerouting

A prominent concern in sanctions analysis is whether targeted commodities are rerouted through third countries to evade detection. For Belarusian potash, there is strong circumstantial evidence of rerouting through Russian ports. Before 2022, Belarus exported the majority of its potash through the Lithuanian port of Klaipėda, with which Belarusian Potash Company (BPC) had a long-standing logistics agreement. The EU sanctions of 2021–2022 closed this route. Belarus subsequently negotiated access to Russian Baltic and Black Sea ports—primarily Ust-Luga and Novorossiysk—for potash exports (Ash & Lukas, 2023).

Whether this rerouting constitutes ”evasion” depends on the legal framing. The EU sanctions on Belarusian potash are origin-based (they apply to goods of Belarusian origin regardless of the export route), so shipping through Russia does not circumvent the EU import restrictions. However, for third-country markets where Belarusian potash is not sanctioned (e.g., Brazil, India, China), the Russian transit route simply represents a logistics adaptation. The available Comtrade data cannot distinguish Belarusian-origin potash shipped from Russian ports from Russian-origin potash, since both would appear under Russian exporter codes in the importer’s customs declaration. This blending of Russian and Belarusian supply chains is a significant complication for sanctions monitoring.

4.5. Aggregate Trade: Shrinkage or Reshuffling?

The evidence points strongly toward reshuffling rather than shrinkage. The Canadian export volume series—the most complete indicator of potash trade available in our data—shows no decline in aggregate

volumes between the pre-sanctions period and 2022–2024. On the contrary, Canadian export volumes were slightly higher in 2023–2024 (22.8–22.9 Mt) than in 2019–2021 (19.6–21.7 Mt). Combined with IFA estimates that global potash production remained stable at approximately 40–42 Mt K_2O equivalent through 2022–2024 (International Fertilizer Association, 2024), the data are consistent with a world in which the same volume of potash is being produced and traded, but through different bilateral routes.

The reshuffling pattern can be summarized as follows:

- The United States reduced Belarusian potash imports to near zero (mandated by law) while continuing to import Russian potash under the OFAC agricultural exemption ($478 million in 2024), and increased Canadian imports.
- The European Union reduced Belarusian potash imports (mandated by quota) and Russian imports (partly through sanctions, partly through buyer caution), substituting with Canadian, Israeli, and Jordanian supply.
- Brazil and India increased Russian potash imports, exploiting the price discount that sanctioned-origin fertilizer commanded in non-sanctioning markets.
- China's shift toward Russian supply, which predated the invasion, continued and likely accelerated through 2022–2024.

5. Discussion

5.1. Food Security vs. Sanctions Policy

The fertilizer exemption embedded in Western sanctions regimes reflects a genuine policy dilemma. Fertilizer is an input to food production, and disrupting its supply can have cascading effects on food availability, particularly for low-income, import-dependent countries. The architects of the sanctions regime recognized this risk and designed carve-outs accordingly. The data confirm that these carve-outs worked: global fertilizer trade volumes did not collapse, and food production in major importing regions was not disrupted by fertilizer shortages (Vos et al., 2023).

However, this success came at a cost. The sanctions regime created a two-tier market: sanctioned-origin fertilizer (Russian, Belarusian) was available at a discount to non-sanctioning buyers (Brazil, India), while non-sanctioned fertilizer (Canadian, Israeli, Jordanian) commanded a premium in sanctioning markets. This price divergence transferred rents from sanctioning countries' farmers—who paid higher fertilizer prices in 2022–2023—to non-sanctioned fertilizer producers, principally Canadian mining companies. It also created an incentive for developing countries to remain outside the sanctions coalition, since participation would mean paying higher fertilizer prices. The sanctions regime thus had the perverse effect of strengthening Russia's trade relationships with major developing economies—Brazil, India, and China—even as it sought to isolate Russia economically.

5.2. Brazil's Strategic Vulnerability

Brazil's dependence on imported fertilizer is among the highest in the world: approximately 85% of its fertilizer consumption is imported, and potash imports account for roughly 95% of consumption (Associação Nacional para Difusão de Adubos, 2023). In 2019, Russia and Belarus together supplied 47.5% of Brazil's potash imports by value (United Nations Comtrade Database, 2025). Brazil did not join the sanctions coalition, and Brazilian imports of Russian fertilizers increased substantially in 2022–2023 (Hebebrand & Laborde, 2023).

This dependence constitutes a strategic vulnerability, but of a particular kind. Brazil is not vulnerable to a Russian supply cutoff—Russia has no incentive to stop selling to Brazil, since fertilizer is one of its few significant non-energy exports that remains internationally marketable. Rather, Brazil is vulnerable to a change in the terms of trade: if Russia were to demand political concessions in exchange for contin-

ued fertilizer supply, or if secondary sanctions were to target Brazilian entities trading with sanctioned Russian firms, Brazil's agricultural sector (which accounts for approximately 25% of GDP) would face severe disruption. This vulnerability has been noted by Brazilian policymakers and has prompted modest investments in domestic potash mining projects (e.g., the Autazes project in Amazonas state), though these are unlikely to materially reduce import dependence before the 2030s (Governo Federal do Brasil, 2022).

5.3. The Potash Oligopoly: Strengthened or Weakened?

One of the most consequential questions raised by the sanctions episode is whether the Russia–Belarus–Canada potash oligopoly has been strengthened or weakened. The evidence is mixed.

On one hand, the sanctions fragmented the oligopoly's coordination mechanisms. Before 2022, the three-country oligopoly operated through two export cartels—Canpotex (Canadian) and BPC (Belarusian)—plus Uralkali (Russian), which had exited the BPC joint venture in 2013. The cartels coordinated production levels to support prices, functioning as a de facto OPEC for potash. Sanctions on BPC and logistical disruptions to Belarusian exports weakened the Belarusian component of this structure, while Uralkali faced financial sanctions that complicated its trading operations. The cartel coordination that had characterized the pre-2022 potash market was substantially eroded (Gnutzmann & Śpiewanowski, 2020).

On the other hand, the remaining non-sanctioned producers—particularly Nutrien and Mosaic in Canada—benefited enormously from the 2022 price spike. Nutrien's potash segment generated record earnings in 2022, and the company accelerated production capacity expansions that had been deferred during the 2010s downturn (Nutrien Ltd, 2023). The long-run effect may be a more concentrated market in which Canadian producers have increased their market share at the expense of Belarus, while Russian producers maintain volume but at discounted prices.

5.4. Fertilizer Affordability in Developing Countries

The 2022 price spike had severe consequences for fertilizer affordability in low-income, import-dependent countries, particularly in Sub-Saharan Africa and South Asia (Arndt et al., 2023). In Ghana, for example, fertilizer prices more than doubled between 2021 and 2022, leading to an estimated 15–20% reduction in fertilizer application rates among smallholder farmers (International Monetary Fund, 2023). The World Bank's food security update for 2023 noted that fertilizer affordability—measured as the ratio of fertilizer prices to crop prices—had deteriorated to levels not seen since the 2008 food crisis in several African countries (World Bank, 2024).

The sanctions regime contributed to this affordability crisis indirectly: by creating uncertainty and a price premium for non-sanctioned fertilizer, it raised the global reference price against which all fertilizer contracts are benchmarked. Developing countries that sourced their fertilizer from non-sanctioned suppliers (or that were unable to access the discounted sanctioned-origin product due to financing or logistics constraints) bore the cost of this premium. International efforts to mitigate the impact—including the US government's $250 million fertilizer affordability initiative and the African Development Bank's African Fertilizer Financing Mechanism—were modest relative to the scale of the problem (US Agency for International Development, 2023).

5.5. The Green Fertilizer Transition

The 2022 crisis accelerated policy interest in alternatives to conventional synthetic fertilizers, but there is little evidence of a structural shift in consumption patterns. The "green fertilizer" agenda encompasses several distinct approaches: (a) green ammonia produced using renewable hydrogen rather than natural gas, (b) enhanced-efficiency fertilizers (EEFs) that reduce nutrient losses, (c) biological nitrogen fixation through microbial inoculants, and (d) organic fertilizers and composting. While investment in green ammonia projects increased substantially after 2022 (with projects announced in Norway, Australia,

Chile, and Kenya), commercial-scale production remains minimal—global green ammonia capacity in 2024 was less than 0.5 Mt, compared with approximately 185 Mt of conventional ammonia production (International Renewable Energy Agency & Ammonia Energy Association, 2024).

The fertilizer price shock of 2022 did, however, spur significant policy innovation. The European Union's Farm to Fork strategy set a target of reducing fertilizer use by 20% by 2030, and the Common Agricultural Policy 2023–2027 introduced new payment mechanisms for nutrient management. India expanded its soil health card program and neem-coated urea mandate, which had already reduced urea consumption by an estimated 10% between 2015 and 2022 (Government of India, Ministry of Chemicals and Fertilizers, 2023). Brazil launched a National Fertilizer Plan (Plano Nacional de Fertilizantes) in 2022, aiming to reduce import dependence from 85% to 45% by 2050 through a combination of domestic production, nutrient recycling, and biological alternatives (Governo Federal do Brasil, 2022).

These initiatives represent genuine policy momentum toward reduced synthetic fertilizer dependence, but they are long-term projects. In the 2022–2024 timeframe covered by this paper, no measurable shift away from conventional potash or urea is visible in the trade data.

6. Limitations

This analysis is subject to several important limitations.

First and most fundamentally, the Comtrade data coverage is incomplete. Russia ceased reporting after 2021, Belarus after 2020. Importer-side data for Brazil, China, India, and the United States is unavailable or truncated for the post-2022 period. Nitrogenous fertilizers (HS 3102) and compound fertilizers (HS 3105) data could not be extracted at all for the selected reporters. The paper's quantitative analysis is therefore concentrated on potash (HS 3104) exports from Canada (complete series) and on the pre-2022 period for Russia and Belarus. The post-2022 analysis relies on secondary sources and indirect evidence, and the claims made for this period should be treated as provisional until complete mirror data becomes available.

Second, the three-country focus on Russia, Belarus, and Canada, while capturing the dominant potash exporters, excludes other significant producers (Israel, Jordan, Germany, China) whose supply responses may have influenced market outcomes. A comprehensive analysis would include these producers and construct a full global supply-demand balance.

Third, unit values derived from Comtrade data are imperfect price proxies. They represent average declared customs values for aggregate bilateral flows and do not correspond to specific contract prices. The actual prices paid by importers may differ from Comtrade-derived unit values due to contract timing, quality differentials, and transfer pricing in intra-firm trade.

Fourth, the paper does not analyze the domestic political economy of the fertilizer trade reshuffling—for example, the lobbying efforts of US and EU farmer organizations that advocated for fertilizer exemptions, or the role of Russian fertilizer exports as a diplomatic tool in Russia's relationships with Brazil, India, and African countries.

Fifth, the environmental dimensions of the trade reshuffling—including the carbon footprint of longer shipping routes and the methane emissions from expanded natural gas-based urea production—are not addressed.

7. Conclusion

This paper has documented the reshuffling of global potash trade following the imposition of Western sanctions on Russia and Belarus after Russia's full-scale invasion of Ukraine in February 2022. Drawing on UN Comtrade bilateral trade data for HS 3104 (potassic fertilizers) for the period 2019–2024, supple-

mented by industry and policy sources, we find clear evidence of substantial trade redirection rather than trade destruction.

Three main findings emerge. First, global potash trade volumes remained stable through the sanctions period. Canadian exports—the most complete data series—were 22.91 Mt in 2024, compared with 19.56 Mt in 2019, an increase of 17%. Russian and Belarusian exports, while subject to greater uncertainty due to reporting gaps, appear from secondary sources to have remained within their pre-sanctions volume range, redirected from Western to non-Western markets. Notably, US imports of Russian HS 3104 continued under the OFAC agricultural exemption, reaching $478 million in 2024.

Second, the sanctions created a pronounced but temporary price premium for non-sanctioned fertilizer. Canadian potash unit values rose 125% from $263/t in 2021 to $592/t in 2022 before declining to $254/t in 2024—essentially the 2019 baseline. This premium generated windfall profits for Canadian producers while imposing costs on farmers in sanctioning countries and on developing countries that could not access discounted sanctioned-origin supply.

Third, the trade reshuffling reinforced rather than weakened the potash oligopoly's underlying structure. Canada increased its market share in Western markets, Russia deepened its trade relationships with Brazil, India, and China, and Belarus lost market share but remained a significant global producer. The three-country concentration of global potash production was not materially altered by the sanctions episode.

The policy implications are sobering. The fertilizer exemption prevented a global food crisis, but at the cost of creating a two-tier market, transferring rents to non-sanctioned producers, and strengthening Russia's trade ties with major developing economies. The episode exposes a structural vulnerability in global food systems: the potash market's extreme geographic concentration means that there is no sanctions regime that can isolate a major producer without imposing costs on food-importing countries. Diversification of potash supply—through new mining projects in countries with suitable geology, nutrient recycling, and long-run shifts toward biological alternatives—remains a strategic imperative that the 2022–2024 crisis has made urgent but not yet achievable.

Statements

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