

Article

Global Agri-Food Competitiveness: Assessing Food Security, Trade, Sustainability, and Innovation in the G20 Nations

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Abstract

This study presents a comparative benchmarking analysis of G20 nations' agri-food competitiveness across five critical pillars: food security and nutrition, trade and geopolitics, environmental sustainability, fiscal regimes, and entrepreneurship support. Using a structured benchmarking framework with 13 performance indicators sourced from internationally recognized datasets, the research delivers a comprehensive evaluation of national agri-food systems. The analysis reveals significant disparities in transparency, policy coherence, and investment in innovation across member states. Countries such as the United States, Germany, and Australia emerge as leaders, driven by integrated policy frameworks, trade surpluses, and sustainable production practices. Others fall behind due to import dependence, fragmented governance, or weak innovation ecosystems. Canada performs consistently in trade metrics but is hindered by high emissions intensity, infrastructure constraints, and a lack of a cohesive national food strategy. Theoretically, this work contributes to the emerging field of agri-food system diagnostics by operationalizing a cross-pillar benchmarking methodology applicable at the national level. Practically, it offers policymakers a decision-support tool for identifying structural gaps and setting reform priorities. The framework enables governments, trade partners, and multilateral institutions to design targeted interventions aimed at boosting food system resilience, economic competitiveness, and sustainability in an era of rising geopolitical and environmental volatility.

Keywords: agri-food competitiveness; benchmarking; food security; global trade; sustainability

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1. Introduction

The COVID-19 pandemic has had a profound effect on food supply chains worldwide and created uneven disparity through altered consumer behavior with regard to food consumption [1]. Many changes have had to be made to the food supply system, although not all countries have adjusted as well as others. Many countries now face challenges in the import and export of food [2].

To achieve net positive outcomes, countries must invest domestically into the future of agriculture and commodities and support those that would create wealth through agricultural technology, food science, and food retail [3]. Similarly, safeguarding against the effects of climate change will allow for long-term investment in crop and livestock production, which will increase food security and nutrition [4]. Because the interdependence

of global food systems may have substantial domestic effects, measuring global influence becomes critical.

Currently, there is no standardized method for measuring the global influence of nations on international food markets. As countries compete for strategic positioning in the global agri-food sector, it becomes increasingly important to assess whether domestic policies and regulatory frameworks are adequate to ensure food security and uphold food sovereignty. Many nations derive a significant portion of their income from agri-food exports, and through this, they maintain considerable market power within global commodity chains [5]. Consequently, these influential countries can significantly shape the flow of agricultural goods worldwide, affecting regions vulnerable to food insecurity due to climate instability or armed conflict.

However, efforts to assess national-level influence are hampered by limitations in data availability. National datasets often suffer from gaps in collection, lack of consistent base-lines, and restricted access to proprietary or firm-level information [6]. These limitations pose challenges in accurately identifying and evaluating the most influential actors in the global agri-food landscape.

This report presents a comparative analysis of the agri-food performance and competitiveness of the 19 G20 countries. By establishing quantifiable benchmarks, this study aims to measure and rank national performance in a way that informs both policy and public understanding. Beyond serving as a tool for policymakers, the rankings are also intended to help the general public and consumers grasp the complex interconnections between global food systems, supply chains, and food geopolitics at the local level.

The G20 nations' capacities for data collection vary. In addition, many national governments also differ in their approaches to data transparency. As a result, there is a considerable disparity in the data available for underlying pillars of competitiveness among these countries.

This study aims to evaluate and compare the agri-food competitiveness of G20 nations through a structured benchmarking framework that assesses five core pillars: food security and nutrition, trade and geopolitics, environmental sustainability, fiscal and retail regimes, and entrepreneurship support. By integrating 13 performance indicators from internationally recognized sources, the research seeks to identify national strengths and gaps, uncover patterns of policy coherence, and highlight areas where innovation and investment are driving competitive advantage. The objective is to offer a practical decision-support tool for policymakers while contributing to the theoretical understanding of agri-food system diagnostics. The central research question guiding this analysis is as follows: How do G20 countries compare in their agri-food competitiveness across key systemic domains, and what policy and structural factors most influence their global performance and influence?

To be more precise, this research lists the nations that use comparative best practices to manage commodities portfolios, encourage new entrants to food markets, and reduce risks associated with climate change and regional conflict on food production and trade. However, the main goal of this benchmarking evaluation is to encourage international conversation on worldwide influence and impact in international commodities markets.

2. Literature Review

Food security, international trade, environmental sustainability, and agri-food competitiveness represent well-established areas of inquiry within academic and policy research. These interconnected domains are central to assessing the resilience of global food systems and their capacity to adapt to and withstand systemic shocks, including pandemics, climate change, and geopolitical instability.

2.1. Food Security and Nutrition

Food security remains a foundational concern in global agricultural research, particularly in light of recent disruptions. The COVID-19 pandemic exposed vulnerabilities in food supply chains, leading to increased disparities in access to nutritious food and significant shifts in consumer behavior worldwide [1]. Many countries experienced interruptions in the movement of agricultural commodities, driven by heightened restrictions on trade logistics and workforce mobility [7]. Food security is commonly defined as the availability and accessibility of sufficient, safe, and nutritious food to meet dietary needs for an active and healthy life [8].

Nations with higher levels of food security are generally characterized by more efficient agricultural systems, improved public health outcomes, and enhanced economic performance through trade [9]. However, recent surges in global food price inflation—coupled with rising costs in housing and energy—have eroded food security, even in traditionally resilient countries [10]. The ongoing geopolitical conflict between Russia and Ukraine has further destabilized global grain markets, disproportionately impacting food-import-dependent regions such as Africa and the Middle East [11]. In this context, national food strategies have emerged as critical policy instruments.

Countries that have articulated comprehensive food security frameworks—emphasizing domestic production, innovation, and supply chain resilience—tend to outperform those without coordinated strategies. For example, Canada's lack of an integrated national food strategy contributes to policy misalignment between agricultural output and nutritional guidance. In contrast, countries such as Saudi Arabia, China, and South Korea have advanced cohesive plans to strengthen food self-sufficiency, while Russia has pursued a sovereignty-based approach focused on key staple crops [12,13].

2.2. Trade and Geopolitics

A country's agri-food competitiveness is deeply influenced by its participation in international trade and its geopolitical positioning. The value of agri-food exports and imports plays a critical role in national wealth generation, food security, and investment attractiveness. Nations with robust agri-food trade surpluses, such as Australia and Canada, tend to exhibit stronger competitive profiles due to their ability to influence global markets. For instance, Canada exports large volumes of raw agricultural commodities but captures limited economic value due to underdeveloped domestic processing capacity [14]. Conversely, countries like China face strategic vulnerabilities due to significant agri-food trade deficits and import dependence [2].

Geopolitical stability is another determinant of agri-food system resilience. Armed conflict, political instability, and corruption can severely disrupt supply chains, generate price volatility, and deter foreign investment. The Russia–Ukraine war has had a particularly destabilizing impact on global agri-food markets by driving up input costs for fertilizers, energy, and feed [15]. Given Russia's significant role in global exports of natural gas and fertilizers, the conflict has introduced long-term uncertainties in global food supply chains [16].

2.3. Sustainability and Environmental Impact

Building upon the geopolitical and trade dimensions of agri-food competitiveness, environmental sustainability represents a parallel imperative. As global food systems become increasingly exposed to climate shocks, sustainability has emerged as a critical factor in long-term agricultural resilience. Sustainable farming practices not only improve soil health, biodiversity, and water efficiency but also reduce greenhouse gas (GHG) emissions—

particularly methane (CH₄) and nitrous oxide (N₂O), which have a far greater warming potential than carbon dioxide [17].

Canada ranks among the highest in per capita agricultural emissions, highlighting the urgency for more effective mitigation policies [18]. In contrast, some emerging economies like India and South Korea have lower emissions footprints while maintaining productive agricultural sectors. Biodiversity protection further enhances sustainability by reducing vulnerability to pests, diseases, and market concentration in a narrow range of crops. While some countries have integrated biotechnology and conservation programs, the persistence of monoculture systems continues to challenge global agricultural resilience [19].

2.4. Retail and Fiscal Regime

Environmental challenges are closely intertwined with structural inefficiencies in agri-food retail and fiscal governance. The concentration of market power among a few dominant grocery retailers—such as Loblaw, Sobeys, and Walmart in Canada—has implications for price formation, supply chain fairness, and innovation incentives. Similar market consolidation trends in other G20 countries have spurred the implementation of regulatory tools such as grocer codes of conduct, aiming to enhance transparency and level the playing field for smaller suppliers [20].

Supply chain coordination and logistical efficiency are also central to competitiveness. Canada's vast geography, while rich in natural resources, imposes high distribution costs and infrastructural demands. Frequent labor disruptions further undermine Canada's reliability as a trade partner, exacerbating challenges in meeting domestic and international demand [21]. These systemic frictions emphasize the need for integrated transport, labor, and regulatory strategies to enhance sector-wide productivity.

2.5. Entrepreneurship and Research and Development

Finally, innovation capacity underpins all previous pillars by enabling countries to adapt to evolving global conditions. Investments in agricultural research and development (R&D) drive productivity, environmental stewardship, and food security outcomes. Countries such as South Korea and Japan consistently lead in R&D expenditure relative to agricultural GDP, translating into greater technological advancement and market agility [12].

Education and human capital development are equally important. A well-trained workforce enhances adaptability to shocks and fosters the commercialization of new technologies. In Canada, despite a strong academic base, misalignment between training programs and industry needs has limited the effectiveness of agri-food innovation ecosystems [22]. Bridging this gap is essential for advancing national competitiveness and reducing dependence on global inputs.

3. Methodology

The MNP (Meyers Norris Penny) Global Influence Index employs a structured benchmarking framework to evaluate and rank the influence of G20 countries in global food markets. This assessment is based on five key areas of influence: entrepreneurship, food security and nutrition, retail and fiscal regime, trade and geopolitics, and environmental sustainability. The study utilizes 13 indicators sourced from reputable organizations such as the World Bank, the Organisation for Economic Co-operation and Development (OECD), and The Economist Intelligence Unit.

The 13 metrics used in this study were selected based on their methodological robustness, policy relevance, and international comparability. Each metric captures a distinct dimension of agri-food competitiveness—ranging from food access and trade balance to emissions intensity and investment in innovation—allowing for a holistic evaluation across five strategic pillars. Indicators were sourced from reputable, internationally recognized databases (e.g., World Bank, OECD, FAO) to ensure data consistency, transparency, and reliability across G20 nations. Priority was given to outcome-based metrics that reflect real-world performance and that can be influenced by public policy, rather than perceptions or inputs alone. The selection process also considered data availability across all countries, the frequency of updates, and alignment with existing global food security and sustainability frameworks. Together, these criteria ensure that the benchmarking results are both methodologically sound and practically actionable.

A three-tiered benchmarking scale was applied to categorize the performance of each country. A similar methodology has been used for past studies [23,24]:

- Tier 1 (High Performance): Metrics in this category represent outstanding performance, significantly exceeding industry standards or expectations.
- Tier 2 (Moderate Performance): Metrics in this category reflect performance meeting industry standards, with room for improvement.
- Tier 3 (Low Performance): Metrics in this category indicate areas requiring significant improvement, falling below industry standards.

The data employed in this study were subjected to a rigorous selection and validation process to ensure their reliability, accessibility, and suitability for capturing national-level competitiveness in the global agri-food sector. Thirteen indicators were selected for their capacity to provide meaningful insights into systemic performance, international comparability, and longitudinal benchmarking across countries. The analysis drew exclusively on secondary data from authoritative sources—such as the World Bank, OECD, FAO, and The Economist Intelligence Unit—all publicly available in English and widely recognized for methodological rigor. Emphasis was placed on outcome-based indicators that reflect observable national performance and are responsive to policy interventions. The indicator selection process was further informed by consultations with international experts in food economics, policy, and agribusiness, thereby enhancing objectivity and minimizing selection bias.

To minimize bias and ensure methodological rigor, the consultation process involved structured feedback sessions with a panel of ten subject-matter experts representing academia, intergovernmental organizations, and the private sector. Experts were provided with a standardized evaluation rubric and asked to assess proposed indicators based on relevance, data quality, comparability, and policy utility. Feedback was aggregated and reviewed anonymously to avoid dominance by individual viewpoints and to maintain objectivity in the final selection of metrics.

Despite these precautions, several limitations persist due to disparities in national data collection standards, lack of transparency, and access restrictions, particularly at the firm level. Moreover, ongoing geopolitical disruptions, such as the Russia–Ukraine conflict, introduce volatility that may temporarily skew results. Countries were ultimately ranked based on their relative competitive positioning, as determined by a composite synthesis of the 13 indicators across five core domains. This benchmarking framework enables the identification of best practices, highlights structural vulnerabilities, and supports evidence-based dialogue on improving global food system resilience and performance.

4. Results

4.1. Food Security and Nutrition Indicator

4.1.1. Food Security and Policy

Food security and a comprehensive food policy at the national level are critical for the health and global competitiveness of a country's agri-food and agribusiness industry. Countries that have high food security are more productive and place higher value on agricultural products, trade opportunities, and job creation [25].

Many events over time, including the COVID-19 pandemic, have caused significant disruptions in the trade of agricultural commodities and retail products worldwide [7]. This has led to delays and difficulties in importing and exporting goods due to increased regulations on the movement of workers and goods across borders.

Food security refers to the state of having an adequate and accessible supply of healthy food in a country [8]. A nation that has attained elevated levels of food security is characterized by enhanced efficiency, improved health, and the ability to generate more money for both individuals and enterprises by augmenting output for international trade [9].

Following the outbreak of the COVID-19 pandemic, several countries have faced challenges in ensuring their own domestic food security. The increasing costs throughout the year continued to be a significant concern for the affordability of food. Globally, continued impacts of rising food price inflation are worsened by increasing costs in housing and energy. Countries that formerly enjoyed robust levels of food security are currently facing elevated costs and climate catastrophes that are impacting the food security rate for their most susceptible populations [10]. Table 1 presents the ranking for food security.

Table 1. Ranking food security [26].

Country	Global Food Security Ranking	Access to Affordable and Nutritious Food
France	80.20	High Performance
Japan	79.50	High Performance
Canada	79.10	High Performance
United Kingdom	78.80	High Performance
United States of America	78.00	High Performance
Germany	77.00	High Performance
Australia	75.40	High Performance
China	74.20	High Performance
Italy	74.00	High Performance
South Korea	70.20	High Performance
Saudi Arabia	69.9	Moderate Performance
Mexico	69.10	Moderate Performance
Russia	69.1	Moderate Performance
Turkey	65.3	Moderate Performance
Brazil	65.10	Moderate Performance
Argentina	64.80	Moderate Performance
South Africa	61.70	Moderate Performance
Indonesia	60.20	Moderate Performance
India	58.90	Low Performance

4.1.2. National Food Strategy

A national food strategy outlines a vision for the development of a future food system that maximizes the benefits of technology, solves issues related to health and the environment, and guarantees the security of the food supply. The level of significance that a country places on food security can be seen in its national plans, as shown in Table 2.

Countries with national food security programs acknowledge the significance and role of a robust agriculture and agri-food industry. Countries that prioritize food security through explicit improvement strategies have enhanced productivity in all sectors, attain higher levels of gross domestic product (GDP), and foster greater levels of innovation within the food industry, ultimately increasing their global competitiveness.

Table 2. Countries with an explicit and comprehensive strategic plan for food policy (scores collated with most recent data from individual country reports, sourced from official websites, 2023).

Country	Year Strategy Released	National Strategies for Improving Food Security
Brazil	2024	High Performance
China	2024	High Performance
Germany	2024	High Performance
India	2024	High Performance
South Korea	2024	High Performance
Australia	2023	High Performance
France	2023	High Performance
Indonesia	2023	High Performance
Mexico	2023	High Performance
Saudi Arabia	2023	High Performance
United States of America	2023	High Performance
Japan	2021	Moderate Performance
United Kingdom	2021	Moderate Performance
Canada	2020	Moderate Performance
Italy	2020	Moderate Performance
Argentina	2020	Moderate Performance
Russia	2019	Moderate Performance
South Africa	...	Low Performance
Turkey	...	Low Performance

Compared with other nations, as presented in Table 3, Canada has a relatively modest food policy, supported by limited resources. The priorities between what is produced domestically and what Canadians are encouraged to consume by Health Canada's Food Guide, refreshed in 2019, are somewhat disconnected. There is a lack of a clear, coherent national vision for Canada's agri-food sector, which is causing the entire sector to lag behind its global peers.

Meanwhile, numerous countries have implemented a comprehensive food strategy that delineates strategies aimed at guaranteeing food security for their populations. Saudi Arabia [27], China [28], and South Korea [29] are implementing measures to increase their domestic agricultural production, while India acknowledges the significance of both local yields and international commerce in attracting investment to its agricultural sector [30]. Russia has prioritized reaching food sovereignty in many staples [31], yet this objective does not necessarily indicate the extent of food security experienced by the Russian population.

Several nations have not yet revised their dietary regulations in light of the COVID-19 epidemic. The current inflationary environment for food prices has undergone substantial changes compared to the pre-pandemic period. Consequently, it is imperative to make major adjustments to these strategies to address the food security challenges expected in a post-pandemic food landscape.

Also, national food strategies and food security are challenged by the fact that crop varieties have dropped significantly. According to the United Nations Environment Programme, "Over the past 100 years, more than 90 per cent of crop varieties have disappeared [leaving] just nine plant species [which] account for 66 per cent of total crop production" [19].

Table 3. Overall scores of food security and policy.

Country	Overall Score	Access to Affordable and Nutritious Food	National Strategies for Improving Food Security
Australia	1.00	High Performance	High Performance
China	1.00	High Performance	High Performance
France	1.00	High Performance	High Performance
Germany	1.00	High Performance	High Performance
South Korea	1.00	High Performance	High Performance
United States of America	1.00	High Performance	High Performance
Brazil	1.50	Moderate Performance	High Performance
Canada	1.50	High Performance	Moderate Performance
Indonesia	1.50	Moderate Performance	High Performance
Italy	1.50	High Performance	Moderate Performance
Japan	1.50	High Performance	Moderate Performance
Mexico	1.50	Moderate Performance	High Performance
Saudi Arabia	1.50	Moderate Performance	High Performance
United Kingdom	1.50	High Performance	Moderate Performance
Argentina	2.00	Moderate Performance	Moderate Performance
India	2.00	Low Performance	High Performance
Russia	2.00	Moderate Performance	Moderate Performance
South Africa	2.50	Moderate Performance	Low Performance
Turkey	2.50	Moderate Performance	Low Performance

4.2. Trade and Geopolitics Indicator

4.2.1. Value of Agri-Food Exports and Imports

The value of food impacts wealth creation and food security and attracts investment (foreign and domestic) and reinvestment by enterprises in the agri-food industry. Without trade, a country's agriculture sector would be smaller, generate less economic activity and jobs. Importantly, a country that exports high volumes of commodities impacts global food security, while imports allow for greater variety in diets. A healthy agri-food export sector encourages innovation and sustainable practices and attracts new entrants. High levels of trade in the agri-food sector suggest that a country is globally competitive.

Table 4, with scores collated with most recent data from individual country reports, sourced from official websites, 2023, exhibits the aggregate trade surplus or deficit in the agriculture sector of a country, measured in USD. A country's trade surplus is linked to its gross domestic product (GDP), meaning that a trade surplus is a strong indicator of an inferred increase in GDP [32]. A negative score indicates a trade deficit, meaning that the country's imports exceed its exports. This survey believes that a trade deficit suggests that a country's control of its agri-food fortunes may be compromised and dependency over other nations increases.

Trade balance serves as a safeguard against sudden and disruptive fluctuations in currency exchange rates and the movement of goods and services. Trade balance might potentially have positive effects on both employment opportunities and domestic manufacturing sectors. Moreover, the balance of trade might indicate that a nation is implementing measures to minimize the impact of potential disruptions in the global markets, such as conflict and climate-related natural catastrophes.

Canada's position, bolstered by its trade surplus, is relatively strong. This indicates that Canada has a measurable but not overwhelming ability to influence through trade. Consequently, while Canada excels in producing raw materials, the benefits of transforming these commodities into high-value products are frequently realized by other countries. This highlights the need for Canada to invest more in domestic processing and innovation to capture greater economic value from its agricultural sector.

Table 4. Agriculture balance of trade.

Country	Trade Balance Value (Billions-USD)	Value of Agri-Food Exports and Imports
Australia	47.5	High Performance
Brazil	29.4	High Performance
Mexico	21.4	High Performance
India	17.9	High Performance
Canada	13.3	High Performance
France	7.9	High Performance
Russia	7.8	High Performance
Turkey	6.8	Moderate Performance
South Africa	5.5	Moderate Performance
Italy	2.4	Moderate Performance
United States of America	−3	Moderate Performance
Argentina	−6.9	Moderate Performance
United Kingdom	−7	Moderate Performance
Indonesia	−10.6	Low Performance
Saudi Arabia	−25.3	Low Performance
Japan	−30.5	Low Performance
Germany	−32.3	Low Performance
South Korea	−36.3	Low Performance
China	−137.4	Low Performance

4.2.2. Political Stability

Conflict, domestic or international, negatively influences agricultural productivity and investment. Conflict disrupts the food supply chain and the distribution of both agricultural inputs and outputs, creates price shocks, and causes massive displacement of labor. Countries involved in conflict are not competitive on a global scale and will suffer reputation damage once the conflict is resolved.

For the measurement of political stability, a composite score taken from the EIU and the UN that includes armed conflict, political stability risk, corruption, and gender inequality is presented in Table 5 [33].

Canada's parliamentary system has served its citizens well, providing a foundation for political stability that has significantly benefited the Canadian economy over time. In fact, many countries with parliamentary systems have similarly experienced positive outcomes in terms of governance and economic performance. This stability has fostered a reliable environment for investment, growth, and innovation, contributing to Canada's robust economic landscape. The consistency and effectiveness of the parliamentary system play a crucial role in maintaining public confidence and supporting long-term economic strategies. The Russia–Ukraine war is arguably the most impactful.

Sanctions on Russia appear to be doing little in the way of securing a resolution to the ongoing conflict and instead, globally, we may anticipate a consequential impact in Europe and countries as distant as Brazil and China in terms of access to important agricultural inputs sources through Russia [34].

Russia also wields substantial power in the worldwide oil and energy sectors [16]. In 2019, it occupied the top spot as the primary global distributor of natural gas, the second most significant distributor of oil, and the third most significant distributor of coal. These sectors accounted for 20%, 11%, and 15% of global exports [35].

Before the current conflict Russia was positioned as an important global agricultural input market provider and, as such, held significant global influence and competitive standing. However, the ongoing conflict as well as the political reactions to the situation have important and perhaps enduring consequences for both producers and consumers globally. Prices have risen for animal feed, energy, and fertilizer [15]. Russia indeed has

significant influence in global food supply chains. Yet the way Russia has secured this influence is short-term and precarious. The long-term impacts on global food from Russia's aggression are uncertain, but so too is Russia's position once this conflict comes to an end. Table 6 offers an overall ranking for trade and geopolitics scores.

Table 5. Political stability.

Country	Political Stability	Political Stability and Policies Impacting Agri-Food Trade
Canada	95.3	High Performance
Australia	94.9	High Performance
Germany	91.5	High Performance
Japan	90.1	High Performance
United Kingdom	87.2	High Performance
France	85.1	High Performance
Italy	82.2	High Performance
United States of America	82.1	High Performance
South Africa	79.1	Moderate Performance
South Korea	72.7	Moderate Performance
China	72	Moderate Performance
Argentina	70.1	Moderate Performance
Brazil	64.4	Moderate Performance
Saudi Arabia	61.4	Moderate Performance
Mexico	59.6	Moderate Performance
Indonesia	55.3	Moderate Performance
India	50.5	Moderate Performance
Turkey	43	Low Performance
Russia	28.6	Low Performance

Table 6. Overall trade and geopolitics score.

Country	Overall Score	Value of Agri-Food Exports and Imports	Political Stability and Policies Impacting Agri-Food Trade
Australia	1.00	High Performance	High Performance
Canada	1.00	High Performance	High Performance
France	1.00	High Performance	High Performance
United Kingdom	1.50	Moderate Performance	High Performance
Brazil	1.50	High Performance	Moderate Performance
India	1.50	High Performance	Moderate Performance
Italy	1.50	Moderate Performance	High Performance
Mexico	1.50	High Performance	Moderate Performance
United States of America	1.50	Moderate Performance	High Performance
Argentina	2.00	Moderate Performance	Moderate Performance
Germany	2.00	Low Performance	High Performance
Japan	2.00	Low Performance	High Performance
Russia	2.00	High Performance	Low Performance
South Africa	2.00	Moderate Performance	Moderate Performance
China	2.50	Low Performance	Moderate Performance
Indonesia	2.50	Low Performance	Moderate Performance
Saudi Arabia	2.50	Low Performance	Moderate Performance
South Korea	2.50	Low Performance	Moderate Performance
Turkey	2.50	Moderate Performance	Low Performance

4.3. Sustainability and Environmental Impact

4.3.1. Sustainable Agriculture Techniques

This theme will only gain in importance in years to come and will define our agri-food systems' competitiveness. The promotion and adoption of sustainable farming practices on farms are shown to reduce food costs, increase the productive capacity of land for feeding an increasing population, releasing labor from the farm, and providing diversity of choice of food throughout the year to consumers. Changing climate demands require investment in innovative solutions to the degradation that agriculture may cause whilst also supporting expanding yields in a sustainable manner. Further, global consumer demands have prioritized sustainable farming practices to ensure the health of livestock and land/water resources for future generations.

Table 7 below lists the sustainability ranking. This score assesses a country's risks and adaptation based on the country's use of antibiotics in the foods grown [36], agricultural productivity [37], and agricultural value [18], adjusted for population [38].

Table 7. Sustainable agriculture ranking.

Country	Sustainability Ranking	Adoption of Sustainable Farming Practices
United Kingdom	0.41	High Performance
Germany	0.53	High Performance
Japan	1.92	High Performance
Turkey	2.21	High Performance
United States of America	2.26	High Performance
France	2.71	High Performance
Italy	2.85	Moderate Performance
South Africa	3.82	Moderate Performance
Australia	4.61	Moderate Performance
Mexico	5.34	Moderate Performance
Saudi Arabia	6.49	Moderate Performance
Canada	7.13	Moderate Performance
Russia	7.23	Moderate Performance
China	8.16	Moderate Performance
Brazil	8.65	Moderate Performance
South Korea	8.77	Moderate Performance
India	9.26	Moderate Performance
Indonesia	10.63	Low Performance
Argentina	27.75	Low Performance

Canada is actively working to honor its Paris Agreement commitment by implementing an aggressive carbon-zero policy that impacts all sectors of the economy. This policy has focused on consistently reducing greenhouse gas emissions over the past several years.

The Canadian government has introduced various measures to achieve these ambitious targets, including regulations, incentives for clean technology, and investments in renewable energy sources. Efforts such as carbon pricing, stricter emissions standards, and support for green infrastructure projects demonstrate a comprehensive approach to addressing climate change. By targeting reductions across multiple sectors, including transportation and agriculture, Canada aims to transition to a more sustainable and resilient economy.

4.3.2. Emissions

Reliance on fossil fuels within the agri-food sector has critical implications for global competitiveness. Emissions from agricultural machinery and equipment contribute significantly to climate change and can negatively affect public health, even in populations

located far from the sites of food production [39]. While much attention is directed toward the overall carbon footprint of corporations and nations, agricultural activities are primarily responsible for the release of two potent greenhouse gases: methane (CH₄) and nitrous oxide (N₂O) [17]. Nation scores regarding these two gases are outlined in Table 8.

Table 8. Total scores of methane and nitrous oxide emissions [40].

Country	Per Capita (Emissions in Metric Tonnes)	Methane and Nitrous Oxide Impact of Agri-Food Production
Saudi Arabia	1.07	High Performance
South Korea	1.08	High Performance
Japan	1.67	High Performance
India	1.87	High Performance
Italy	2.12	High Performance
China	2.15	High Performance
Indonesia	2.48	High Performance
South Africa	2.70	High Performance
Germany	3.09	Moderate Performance
Mexico	3.13	Moderate Performance
Turkey	3.58	Moderate Performance
United Kingdom	3.59	Moderate Performance
Russia	3.61	Moderate Performance
France	4.54	Moderate Performance
United States of America	5.40	Moderate Performance
Canada	9.30	Low Performance
Brazil	9.35	Low Performance
Argentina	11.19	Low Performance
Australia	21.11	Low Performance

4.3.3. Biodiversity

Biodiversity in domesticated crops and animals guarantees the gene pool for disease resistance. Relying on a limited number of plant types exposes our food supply to vulnerabilities brought on by climate change and illness. Preserving biodiversity in crops and animals provides diverse foods that are culturally specific to diets worldwide and mitigates against genetic erosion. Modern crop varieties offer consistency and high yields, but they often rely on intensive chemical inputs and thrive best under industrial agricultural techniques as monocultures. Countries with low biodiversity in yields may be reliant on a few commodities in the global market, are vulnerable to risks from disease, have high input costs, and are dependent on costly inputs from suppliers, adding another layer of risk from the supply chain. Monoculture agriculture has limited innovation potential. Table 9 ranks countries based on biodiversity commitment.

Table 9. Biodiversity commitment (scores collated with most recent data from individual country reports, sourced from official websites, 2023).

Country	National Policy and Programs Supporting Biodiversity in Agriculture	Biodiversity and Conservation Efforts in Agriculture
Australia	2022	High Performance
Brazil	2022	High Performance
Canada	2023	High Performance
China	2022	High Performance
France	2023	High Performance

Table 9. Cont.

Country	National Policy and Programs Supporting Biodiversity in Agriculture	Biodiversity and Conservation Efforts in Agriculture
Germany	2023	High Performance
India	2023	High Performance
Indonesia	2024	High Performance
Japan	2023	High Performance
Mexico	2023	High Performance
Saudi Arabia	2023	High Performance
South Africa	2023	High Performance
South Korea	2023	High Performance
United States of America	2023	High Performance
Russia	2019	Moderate Performance
United Kingdom	2021	Moderate Performance
Argentina	...	Low Performance
Italy	...	Low Performance
Turkey	...	Low Performance

4.3.4. Climate Event Impacts on Agri-Food Production and Logistics

Extreme weather conditions hinder agricultural growth, particularly floods and droughts, which can damage crops and lower output. Canada has had its share of weather-related incidents, with heat domes, atmospheric rivers, consistent droughts in western Canada, and more. Adverse weather impacts agricultural economies worldwide; those who are better equipped to pivot production, defend against adversity, and cut input costs will have higher yields and be more competitive in the global market.

Water, whether due to excessive flooding, prolonged droughts, contamination, insufficiency, excessive nutrient levels, or the loss of marine species, has significant agricultural impacts for global competitiveness. Demonstrating dedication to mitigating risks associated with climate change necessitates adopting a strategic approach that encompasses medium- to long-term perspectives. This is easier to accomplish in more established, politically stable countries that enjoy significant agricultural trade. Table 10 below offers an overall sustainability ranking.

Table 10. Overall sustainability score.

Country	Score	Adoption of Sustainable Farming Practices	Carbon Footprint and Environmental Impact of Agri-Food Production	Biodiversity and Conservation Efforts in Agriculture
Argentina	2.25	Low Performance	Low Performance	Low Performance
Australia	1.5	Moderate Performance	Low Performance	High Performance
Brazil	1.5	Moderate Performance	Low Performance	High Performance
Canada	1.5	Moderate Performance	Low Performance	High Performance
China	1	Moderate Performance	High Performance	High Performance
France	1	High Performance	Moderate Performance	High Performance
Germany	1	High Performance	Moderate Performance	High Performance
India	1	Moderate Performance	High Performance	High Performance
Indonesia	1.25	Low Performance	High Performance	High Performance
Italy	1.5	Moderate Performance	High Performance	Low Performance
Japan	0.75	High Performance	High Performance	High Performance
Mexico	1.25	Moderate Performance	Moderate Performance	High Performance
Russia	1.5	Moderate Performance	Moderate Performance	Moderate Performance
Saudi Arabia	1	Moderate Performance	High Performance	High Performance
South Africa	1	Moderate Performance	High Performance	High Performance
South Korea	1	Moderate Performance	High Performance	High Performance
Türkiye	1.5	High Performance	Moderate Performance	Low Performance
United Kingdom	1.25	High Performance	Moderate Performance	Moderate Performance
United States of America	1	High Performance	Moderate Performance	High Performance

4.4. Retail and Fiscal Regime

4.4.1. Grocer Market Share

In Canada, Loblaw is the dominant player in the grocery market, followed by Empire-Sobeys, Metro, Walmart, and Costco. These grocers control a significant portion of the Canadian market. Increased consolidation in the sector has been largely driven by the entry of American retailers, such as Costco and Walmart, which pressured the top three Canadian grocers to respond by consolidating through acquisitions. While this consolidation has strengthened their market positions, it has posed challenges for food manufacturers and the survival of independent grocers. The market shares of the top three major retailers by country are presented in Table 11.

Table 11. Market share of top 3 major retailers [41].

Country	Market Share of Top 3 Major Retailers	Market Share and Influence of Major Agri-Food Retailers
Italy	31.1	High Performance
United States of America	33.4	High Performance
Japan	34.8	High Performance
Mexico	42.4	Moderate Performance
Germany	45.4	Moderate Performance
France	51	Moderate Performance
Saudi Arabia	55.1	Moderate Performance
Russia	55.7	Moderate Performance
Argentina	58.1	Moderate Performance
Brazil	59	Moderate Performance
United Kingdom	60.9	Low Performance
Indonesia	62.7	Low Performance
Canada	65.2	Moderate Performance
South Korea	65.3	Low Performance
China	69.4	Low Performance
South Africa	77.1	Low Performance
Australia	78.4	Low Performance
Turkey	80	Low Performance
India	89.2	Low Performance

Implementing a grocer code of conduct, similar to those in Australia and the United Kingdom, would greatly benefit manufacturers and independent grocers. Such a code would promote fair practices, enhance competition, and support the overall health and sustainability of Canada's agri-food industry.

4.4.2. Logistics

With its vast and varied topography, Canada faces significant logistical challenges. The distribution of goods across such a large and diverse landscape incurs high costs, which tend to increase with rising energy prices. This geographical complexity requires extensive transportation networks, further driving up operational expenses. Frequent labor disruptions have negatively impacted Canada's global reputation, particularly in terms of reliability. Strikes and labor disputes can lead to delays and inconsistencies in the supply chain, making Canada appear as an unreliable trade partner, especially to the United States.

Planning and logistics rankings from the World Bank's Logistics Performance Index are presented in Table 12. With its vast and varied topography, Canada faces significant logistical challenges. The distribution of goods across such a large and diverse landscape incurs high costs, which tend to increase with rising energy prices. This geographical complexity requires extensive transportation networks, further driving up operational expenses. Frequent labor disruptions have negatively impacted Canada's global reputation, particularly in terms of reliability. Strikes and labor disputes can lead to delays and inconsistencies in the supply chain, making Canada appear as an unreliable trade partner,

especially to the United States. These disruptions not only affect domestic markets but also hinder international trade relations, potentially causing partners to seek more stable and predictable alternatives. “For its agri-food competitiveness, Canada’s topography is both a blessing and a curse. It provides the country with an abundance of resources, but the large distances involved make distribution a costly endeavor”.

Table 12. Planning and logistics ranking [21].

Country	Planning and Logistics Ranking	Concentration and Coordination in the Supply Channel
Germany	80.0	High Performance
Japan	75.8	High Performance
United Kingdom	74.8	High Performance
United States of America	72.3	High Performance
France	71.0	High Performance
South Africa	69.5	Moderate Performance
China	69.3	Moderate Performance
Australia	68.8	Moderate Performance
Italy	68.5	Moderate Performance
Canada	68.3	Moderate Performance
South Korea	65.3	Moderate Performance
Saudi Arabia	64.2	Moderate Performance
Indonesia	53.8	Moderate Performance
Turkey	53.8	Moderate Performance
India	51.5	Moderate Performance
Mexico	51.2	Moderate Performance
Brazil	49.8	Low Performance
Argentina	47.3	Low Performance
Russia	44.0	Low Performance

Table 13 provides a synthesis of Section 4.4, summarizing the retail and fiscal regimes of the countries studied.

Table 13. Overall retail and fiscal regime score.

Country	Score	Market Share and Influence of Major Agri-Food Retailers	Concentration and Coordination in the Supply Channel
United States of America	1.00	High Performance	High Performance
Germany	1.67	Moderate Performance	High Performance
France	1.67	Moderate Performance	High Performance
Italy	1.67	High Performance	Moderate Performance
Japan	1.67	High Performance	High Performance
Australia	2.00	Low Performance	Moderate Performance
United Kingdom	2.00	Low Performance	High Performance
Saudi Arabia	2.00	Moderate Performance	Moderate Performance
Canada	2.00	Moderate Performance	Moderate Performance
Mexico	2.00	Moderate Performance	Moderate Performance
Indonesia	2.33	Low Performance	Moderate Performance
South Africa	2.33	Low Performance	Moderate Performance
Russia	2.33	Moderate Performance	Low Performance
China	2.33	Low Performance	Moderate Performance
Argentina	2.67	Moderate Performance	Low Performance
Brazil	2.67	Moderate Performance	Low Performance
India	2.67	Low Performance	Moderate Performance
Turkey	2.67	Low Performance	Moderate Performance
South Korea	2.67	Low Performance	Moderate Performance

4.5. Entrepreneurship Ecosystem Support

4.5.1. Research and Development

The metric, presented in Table 14, measures a country's ability to create a strong agri-food research and innovation system that allows it to become a reliable supplier of agri-food that is both safe and affordable while also being produced with environmental sustainability. High investment in agricultural and food research and development suggests a healthy environment for wealth creation and growth that will lead to higher outputs for the global market.

Table 14. Research and development ranking [12].

Country	R&D Ranking	Investment in Agri-Food Research and Innovation
South Korea	100	High Performance
Japan	100	High Performance
China	93.3	High Performance
United States of America	60.7	High Performance
South Africa	48.9	Moderate Performance
Germany	44.4	Moderate Performance
Canada	44.4	Moderate Performance
India	39.3	Moderate Performance
United Kingdom	36.3	Moderate Performance
Turkey	30.4	Moderate Performance
Australia	23	Low Performance
Saudi Arabia	22.5	Low Performance
Indonesia	21.5	Low Performance
Russia	19.3	Low Performance
Mexico	19.3	Low Performance
Italy	18.5	Low Performance
France	17	Low Performance
Brazil	11.9	Low Performance
Argentina	5.2	Low Performance

4.5.2. Education

The ranking regarding access to ag related education is provided in Table 15. Access to ag-tech and agri-food education in Canada is beneficial, but it faces several challenges that prevent it from being ideal. The funding for ag-tech and agri-food education is often insufficient. While Canada's education system is strong, there is a clear disconnect between how students are trained at all levels and the needs of the industry.

Higher levels of education allow producers to navigate more successfully through external shocks and pivot when necessary. Educated producers are more likely to hire a more diverse workforce and have ideas for innovation. However, challenges in attracting and retaining top talent also hinder Canada's R&D capabilities. Researchers may seek opportunities in countries with more robust funding and better infrastructure, leading to a brain drain that impacts the quality of research. The countries scoring in this area is shown in Table 16.

Table 15. Access to education and resources ranking [22].

Country	Access to Ag-Tech Education and Resources Ranking	Access to Managerial Training for Agri-Food Businesses
Argentina	81.6	High Performance
Saudi Arabia	70.5	High Performance
Russia	65.5	High Performance
South Korea	62	High Performance
United Kingdom	60.5	High Performance
Germany	57.4	Moderate Performance

Table 15. Cont.

Country	Access to Ag-Tech Education and Resources Ranking	Access to Managerial Training for Agri-Food Businesses
Canada	57	Moderate Performance
France	55	Moderate Performance
Turkey	54.7	Moderate Performance
Japan	52.5	Moderate Performance
India	52.2	Moderate Performance
Indonesia	52.2	Moderate Performance
China	50	Moderate Performance
Mexico	50	Moderate Performance
Brazil	50	Moderate Performance
South Africa	43.1	Low Performance
Italy	42.2	Low Performance
United States of America	38.1	Low Performance
Australia	28.7	Low Performance

Table 16. Overall scores for entrepreneurship.

Country	Score	Investment in Agri-Food Research and Innovation	Access to Managerial Training for Agri-Food Businesses
South Korea	1.00	High Performance	High Performance
China	1.50	High Performance	Moderate Performance
Japan	1.50	High Performance	Moderate Performance
United Kingdom	1.50	Moderate Performance	High Performance
Argentina	2.00	Low Performance	High Performance
Canada	2.00	Moderate Performance	Moderate Performance
Germany	2.00	Moderate Performance	Moderate Performance
India	2.00	Moderate Performance	Moderate Performance
Russia	2.00	Low Performance	High Performance
Saudi Arabia	2.00	Low Performance	High Performance
Turkey	2.00	Moderate Performance	Moderate Performance
United States of America	2.00	High Performance	Low Performance
Brazil	2.50	Low Performance	Moderate Performance
France	2.50	Low Performance	Moderate Performance
Indonesia	2.50	Low Performance	Moderate Performance
Mexico	2.50	Low Performance	Moderate Performance
South Africa	2.50	Moderate Performance	Low Performance
Australia	3.00	Low Performance	Low Performance
Italy	3.00	Low Performance	Low Performance

4.6. Global Influence

This global study ranks influence in agri-food markets by tier, as shown in Table 17.

Tier 1 nations demonstrated excellent performance in comparison to other countries worldwide, according to the evaluation of 12 performance metrics in this study. The United States, specifically, received outstanding scores in the majority of performance measures. It is important to acknowledge that the findings of this study should be evaluated in relation to other factors or circumstances. The comparative study conducted among the nations included in the sample will be valuable to industry and food authorities.

Table 17. Global influence performance compared.

Country	Overall Score	Tier
United States of America	1.19	Tier 1
Japan	1.40	Tier 1
China	1.44	Tier 1
Germany	1.50	Tier 1
United Kingdom	1.51	Tier 2
India	1.53	Tier 2

Table 17. *Cont.*

Country	Overall Score	Tier
South Korea	1.53	Tier 2
France	1.58	Tier 2
Brazil	1.61	Tier 2
Mexico	1.68	Tier 2
Australia	1.69	Tier 2
Russia	1.69	Tier 2
Canada	1.72	Tier 2
Italy	1.75	Tier 3
Saudi Arabia	1.89	Tier 3
Turkey	2.03	Tier 3
Indonesia	2.07	Tier 3
South Africa	2.11	Tier 3
Argentina	2.15	Tier 3

5. Discussion and Conclusions

5.1. Discussion

The findings of this study underscore the interconnected and multifaceted nature of food security, agri-food trade, environmental sustainability, retail market dynamics, and research and development across G20 nations. While some countries demonstrate strong performance in food security and trade balance, others face structural challenges linked to climate vulnerability, geopolitical tensions, and market concentration. This benchmarking analysis reveals not only where countries stand but also why disparities in competitiveness persist.

A central theme emerging from the study is the strategic importance of food security in determining global agri-food competitiveness. Countries that have implemented comprehensive national food strategies and built resilient supply chains tend to show greater economic stability and social cohesion. However, the results clearly indicate that food security is not solely a function of domestic agricultural output. It is equally shaped by trade policy frameworks, import diversification, and geopolitical stability. Countries exposed to import dependency or conflict-driven supply disruptions remain especially vulnerable.

Trade and geopolitics remain decisive forces in global food system performance. The analysis confirms that major exporters such as Canada, Brazil, and the United States exert substantial influence in global markets due to surplus production capacity. However, their limited capacity for value-added processing and downstream market control constrains domestic economic gains. Furthermore, conflicts like the Russia–Ukraine war continue to destabilize global supply chains, raising input costs and undermining food access in dependent regions—particularly in parts of Africa and the Middle East.

Sustainability presents an ongoing challenge for long-term agri-food competitiveness. Countries with high emissions intensity, land degradation, or weak climate adaptation policies face growing systemic risks. While France and Germany stand out for their commitment to sustainable agricultural practices and environmental accountability, others—most notably Canada—continue to struggle with high per capita emissions and slow adoption of low-impact technologies. Despite Canada’s resource advantage, scaling sustainable practices remains limited by infrastructure, regulatory complexity, and inconsistent policy coordination.

The analysis of retail and fiscal regimes highlights another structural constraint: excessive market concentration. In countries like Canada and the United States, a handful of dominant grocery retailers exert disproportionate control over supply chains, leading to downward pressure on suppliers and limited price transparency for consumers. The introduction of regulatory instruments, such as a grocer code of conduct—as implemented

in the UK and Australia—could improve market equity and support smaller producers and independent retailers.

Finally, innovation capacity through research and development (R&D) emerged as a critical driver of global agri-food leadership. While Canada has made noteworthy public investments in agri-food R&D, progress is hindered by underwhelming private-sector engagement and a regulatory environment that slows the deployment of emerging technologies. In contrast, countries such as China and the United States have invested heavily in agri-tech innovation, creating favorable conditions for rapid commercialization, international competitiveness, and domestic food system transformation.

Overall, the study illustrates that global agri-food competitiveness is shaped by the strategic alignment of policy, innovation, sustainability, and trade. Countries that proactively integrate these elements are better positioned to withstand global shocks, capitalize on market opportunities, and contribute to a more secure and sustainable food future.

5.2. Conclusions

This study highlights the structural complexity of global food systems and identifies the key pillars—food security, trade balance, sustainability, and innovation—that shape national agri-food competitiveness. These factors are not independent; they are deeply interrelated and must be addressed collectively to build resilient food systems capable of withstanding the shocks of pandemics, climate change, and geopolitical disruption.

What emerges clearly is that global agri-food competitiveness is not a byproduct of natural endowments or economic scale alone—it is the outcome of deliberate, long-term policy alignment and investment. Countries that integrate sustainability goals with open, diversified trade strategies and robust innovation ecosystems are not only more resilient but also more capable of shaping global food rules, standards, and markets.

For policymakers, the imperative is clear: failing to act on emissions, trade dependencies, or innovation gaps will result in lost influence, economic vulnerability, and declining competitiveness. Conversely, nations that treat agri-food as a strategic sector—by fostering cross-sector collaboration and addressing structural inefficiencies—will be the ones setting the agenda in tomorrow's food economy. As competition intensifies and the global landscape grows more volatile, aligning domestic priorities with international influence is no longer optional—it is the new benchmark for success.

6. Limitations

While the benchmarking approach applied in this study builds on established methodologies used in previous research [23,24,42,43], several limitations must be acknowledged. A key constraint is the availability, consistency, and quality of data across G20 nations. Differences in data collection protocols, reporting standards, and transparency levels may introduce variability in indicator reliability, which can influence the comparability and interpretation of cross-country rankings.

Another significant limitation lies in the national-level focus of the analysis. Agri-food competitiveness is often shaped by subnational or regional dynamics, including localized climate conditions, infrastructure disparities, and varying provincial or state-level agricultural policies. These intra-country differences are particularly relevant in geographically large and administratively decentralized nations such as Canada, the United States, Brazil, and India. Future studies should adopt a more granular, region-specific framework to capture these internal variations and provide a clearer picture of national performance diversity.

Additionally, this study is grounded in quantitative indicators, which—while offering a standardized benchmarking approach—do not fully capture qualitative dimensions such as cultural food preferences, historical trade alliances, institutional capacity, or political stability. These contextual factors play a non-negligible role in shaping national agri-food strategies and market behavior. Incorporating mixed-method approaches and expert interviews in future research could enhance the explanatory power of agri-food competitiveness models and support more informed policy recommendations.

7. Directions for Future Research

Future research should explore the impact of emerging technologies, such as artificial intelligence, precision agriculture, and blockchain, on agri-food supply chains and global trade dynamics. These technologies have the potential to improve food security, reduce environmental impact, and enhance efficiency in agricultural production and distribution.

Additionally, further studies should investigate the long-term effects of climate change on agri-food systems, particularly in vulnerable regions. Understanding how different nations adapt to climate-related disruptions can provide valuable insights into best practices for mitigating risks associated with extreme weather events and resource scarcity.

Lastly, more research is needed on the socio-economic implications of agri-food market consolidation. Examining how large retailers and multinational corporations influence pricing, food accessibility, and producer profitability can help inform policy interventions aimed at promoting a more equitable and sustainable food system.

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