Food and Agriculture Organization of the United Nations

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THE STATE OF AGRICULTURAL COMMODITY MARKETS

TRADE, RESILIENCE AND FOOD SECURITY
GLOBAL FOOD MARKETS UNDER STRESS

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POLAND. A storm gathers over a field of wheat.

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Food and Agriculture Organization of the United Nations
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FOREWORD

Global agrifood markets are a cornerstone of food security. By connecting local, national and regional scales, they help to ensure that food can move from competitive areas to areas of need.

The volume of agrifood trade more than doubled between 2000 and 2024. As global markets have become increasingly interconnected, they have played a crucial role in transforming agrifood systems, contributing to economic growth, improving livelihoods and expanding access to more affordable foods for millions of people around the world.

At the same time, agrifood markets are operating in an era marked by recurrent, increasingly severe and overlapping shocks, including extreme weather events, conflicts, pandemics, financial crises, disease outbreaks, and sharp increases in energy and agricultural input prices. These shocks have disrupted production, trade flows and markets, exposing vulnerabilities across food supply chains. In a highly interconnected global economy, disruptions originating in one region can rapidly propagate across borders, affecting food availability, affordability and accessibility far beyond the location of the initial shock.

Against this backdrop, the resilience of global agrifood markets has become more visible to global food security. This edition of *The State of Agricultural Commodity Markets* examines how agrifood markets respond to shocks and assesses the resilience of the global agrifood trade network. The report analyses how disruptions are transmitted across countries through trade linkages, identifies vulnerabilities associated with different trade network structures and levels of connectivity, and evaluates the implications of shocks for food security.

The report also demonstrates that resilience depends not only on the structure of global markets, but equally on policy choices. During periods of crisis, governments often adopt measures aimed at insulating domestic markets from rising international prices and supply disruptions. While such actions may provide short-term relief, their widespread and simultaneous use can intensify pressures on global markets, increase price volatility, weaken the stabilizing role of trade and exacerbate food insecurity elsewhere. By contrast, transparent, predictable and cooperative policy approaches can strengthen confidence in international markets and support smoother and more effective adjustment during periods of stress.

The findings strongly reinforce the vision set out in the Food and Agriculture Organization of the United Nation's (FAO) Strategic Framework 2022–2031. Building more efficient, more inclusive, more resilient and more sustainable agrifood systems is essential for addressing the interconnected challenges facing agrifood markets today. Strengthening resilience contributes directly to the four betters – better production, better nutrition, a better environment and a better life – leaving no one behind.

The report further highlights the importance of strengthened international cooperation, enhanced policy coordination and a well-functioning multilateral trading system for resilient agrifood systems. Open, transparent and rules-based trade can strengthen resilience by diversifying sources of supply, facilitating adjustment during periods of stress and improving access to food. At the same time, trade alone cannot guarantee food security. Complementary investments in infrastructure, market information systems, social protection and measures to strengthen the resilient agrifood systems remain essential, particularly for vulnerable countries and populations.

As shocks become increasingly interconnected, systemic and persistent, collective action will become more important than ever. The findings of this report underline that all countries can benefit from stronger international cooperation, well-functioning and integrated trade networks, and greater trust in the multilateral trading system. Conversely, all countries stand to lose from fragmentation, uncertainty and declining cooperation. This is especially true for the poorest and most vulnerable countries and populations, for whom access to stable and affordable food imports can be critical for food security and livelihoods.

Building resilient global agrifood markets, therefore, will require sustained commitment to cooperation, transparency and shared responsibility to address the complex challenges facing agrifood systems today.

FAO remains fully committed to supporting Members in strengthening the resilience of agrifood systems and global agrifood markets through evidence-based analysis, data-based policy support, market transparency initiatives and international cooperation.

Qu Dongyu
FAO Director-General

METHODOLOGY

The work on the 2026 edition of *The State of Agricultural Commodity Markets* began in September 2025. The research and writing team was composed of five staff members of the Food and Agriculture Organization of the United Nations (FAO) who were responsible for the data analysis, research and writing of the report.

Considering the complex modelling work required to inform the writing of the report, FAO engaged leading external experts in food and agricultural trade to produce additional analytical work as follows:

For **Part 2**, a trade network model was used to simulate the propagation of weather shocks across the global trade networks of wheat, maize and rice. Two hypothetical scenarios were simulated. First, a scenario considering extreme weather events affecting a single, critical exporter and ensuing effects on other countries. Second, a scenario in which multiple simultaneous extreme weather events affect crop production around the world.

For **Part 3**, an econometric model was employed to quantify the dynamic impacts and relationships between extreme weather events, trade policy responses and countries' connectivity in the global trade network on bilateral trade flows. FAO also engaged external partners for the preparation of country case studies on how weather shocks affect agricultural production, food security and nutrition, and how trade and trade policies adjusted in response.

For **Part 4**, an econometric modelling exercise was performed to quantify the velocity and magnitude at which weather shocks, affecting the world prices for wheat, maize and rice, propagate and pass through to the domestic markets of selected countries, and to assess whether those shocks are mitigated or amplified by trade policies.

The manuscript was reviewed extensively by internal and external experts who provided substantive comments and advice on the analysis. The report was reviewed and discussed by the management team of the FAO Economic and Social Development stream in May 2026.

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The State of Agricultural Commodity Markets 2026 was prepared by a multidisciplinary team of the Food and Agriculture Organization of the United Nations (FAO) under the coordination of George Rapsomanikis, Senior Economist and Andrea Zimmermann, Economist, editors of this report. The publication was developed under the overall guidance of Máximo Torero Cullen, Chief Economist and the direction of Boubaker Ben-Belhassen, Director of the Markets and Trade Division. The management team of the Economic and Social Development stream provided additional valuable insights.

Research and writing team
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Data
Data management and analysis was provided by Husam Attaallah and Andrea Zimmermann.

External reviewers
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ABBREVIATIONS

AMIS Agricultural Market Information System

CFTC United States Commodity Futures Trading Commission

COVID-19 novel coronavirus disease

FAO Food and Agriculture Organization of the United Nations

FOB free on board

GATT General Agreement on Tariffs and Trade

GDP gross domestic product

G20 Group of Twenty

ICA International Commodity Agreement

IOSCO International Organization of Securities Commissions

NFA National Food Agency (Philippines)

SPEI Standardized Precipitation Evapotranspiration Index

UNCTAD United Nations Conference on Trade and Development

UNDRR United Nations Office for Disaster Risk Reduction

USD United States Dollar

WHO World Health Organization

WTO World Trade Organization

CORE MESSAGES

1 Global food and agricultural markets are operating in an era of heightened uncertainty driven by extreme weather events, financial disturbances, geopolitical tensions and conflicts, pandemics, outbreaks of diseases and pests, energy price fluctuations, and socioeconomic crises. These shocks affect supply, demand, prices and trade flows, and their effects can be transitory or persistent.

2 Global food and agricultural trade has proven resilient, but shocks can still lead to substantial short-term disruptions. So far, these effects have been transitory, pointing to the capacity of the global markets to absorb, adapt to and recover from shocks. Nevertheless, even short-term effects can give rise to significant food security risks.

3 Global food trade networks have become denser and more interconnected, with countries trading with a larger number of partners than in the past. This increased connectivity enhances resilience by providing alternative sourcing options when disruptions occur. Nevertheless, cereal trade networks remain highly concentrated. Only a few exporters account for a large share of global cereal exports, creating efficiency gains under normal conditions but significant vulnerabilities under stress.

4 Shocks to global food commodity markets give rise to significant price effects, which can transmit to domestic markets, driving food insecurity and adverse nutrition outcomes. The lower the buffer capacity of a market, the higher the price spike. Trade expansion can contribute towards global markets that are more resilient to shocks.

5 In the event of a shock, trade policies by major players aiming to insulate domestic markets test the resilience of global food commodity markets. Export restrictions withdraw supplies from the global market, while import facilitation strengthens demand. This further exacerbates the shock's effect on world prices, driving them higher.

6 Food stocks are an integral component of resilience strategies. Maintaining large buffer stocks to stabilize domestic prices distorts markets and has proven to be highly costly and fiscally unsustainable. Emergency food reserves, combined with well-targeted social protection measures, such as cash transfers and food assistance, have proven to be more effective in protecting vulnerable populations during crises.

7 Effective integration in global food markets and well-diversified trade connectivity are long-term strategies to build and strengthen resilience to shocks. Evidence from past crises and the findings in this report indicate that, in the event of a major shock, all countries stand to gain from international cooperation.

EXECUTIVE SUMMARY

Global food and agricultural markets are operating in an era of heightened uncertainty driven by extreme weather events, conflicts and geopolitical tensions, economic shocks, pandemics and recurrent systemic risks. The experience of recent decades shows that markets can be resilient, but only when supported by appropriate policies and international cooperation.

The State of Agricultural Commodity Markets 2026 demonstrates that resilience is strengthened not by retreating from trade, but by reinforcing it through openness, diversified trade partners, cooperation and effective policies. In an increasingly interconnected world, safeguarding global food security requires collective action and a shared commitment to keeping food markets open and well-functioning, especially in times of crisis.

GLOBAL FOOD MARKETS UNDER RECURRENT STRESS

Since 2000, global food and agricultural markets have been exposed to a sequence of shocks, including extreme weather events, pandemics, conflicts, financial crises, and sharp increases in energy and fertilizer prices. These shocks have repeatedly disrupted production, trade flows and prices, raising concerns about the capacity of global food markets to ensure stable access to food, particularly for net food-importing countries and vulnerable populations.

Over the same period, food and agricultural trade has expanded rapidly. The value of global food trade has increased almost fivefold, reaching approximately USD 2 trillion, and global markets have become a central pillar of food security. By reallocating food from surplus to deficit regions, trade supports food availability, stabilizes supplies and prices, and facilitates access to more diverse and nutritious diets. At the same time, growing interdependence between countries has also increased exposure to external shocks and raised concerns that disruptions in one part of the world may propagate globally.

The State of Agricultural Commodity Markets 2026 examines whether global food markets are resilient to shocks, how shocks propagate through international trade networks and which policy choices strengthen or undermine resilience. The report focuses on staple cereals – wheat, maize and rice – which account for a large share of global calorie intake and are central to food security, especially in low-income and net food-importing developing countries.

RESILIENCE AND VULNERABILITY IN GLOBAL FOOD MARKETS

In this analysis, resilience reflects the global food and agricultural markets' ability to absorb shocks and limit the incidence of food price spikes. Trade can ensure that region-specific shocks partially offset one another at the global level. This makes trade a powerful engine to even out supply fluctuations caused by local shocks around the globe or significantly mitigate the impacts of global disruptions. At the same time, vulnerability reflects the likelihood that shocks disrupt trade flows, potentially limiting the movement of food and agricultural products, generating food price volatility and posing risks for food security.

The report finds that global food and agricultural markets have generally demonstrated resilience over the past two decades. Despite severe disruptions, trade volumes have typically adjusted and recovered relatively quickly, including during the 2007–2008 global food price crisis, the COVID-19 pandemic and the initial phase of the war in Ukraine. Food trade has continued to expand even when overall merchandise trade contracted, reflecting the essential nature of food commodities.

However, this aggregate resilience conceals substantial heterogeneity across commodities and countries. Staple cereal markets are structurally more vulnerable than aggregate food trade, due to high concentration among a small number of exporters. Net food-importing low-income countries and Small Island Developing States are particularly exposed, given their dependence on imports and their limited fiscal capacity to cushion shocks. At the household level, the effects of shocks can have significant implications for food security.

The analysis highlights that resilience depends on the structure of trade networks, the degree of trade connectivity, trade intensity and, crucially, policy responses adopted during crises.

TRADE NETWORK STRUCTURES SHAPE RESILIENCE TO SHOCKS: DIVERSIFICATION OF SUPPLIERS REDUCES EXPOSURE TO SHOCKS, BUT NETWORK CONCENTRATION REMAINS AN ISSUE FOR CEREALS

Global food trade networks have become denser and more interconnected, with countries trading with a larger number of partners than in the past. This increased connectivity generally enhances resilience by providing alternative sourcing options when disruptions occur.

Nevertheless, cereal trade networks remain highly concentrated. A small group of exporters accounts for a large share of global wheat, maize and rice exports, creating efficiency gains under normal conditions but significant vulnerabilities under stress. Trade intensity also varies across cereals: wheat and maize are relatively highly traded, while rice markets are characterized by lower trade shares. For these cereal trade networks, core periphery structures persist, with many countries relying on a limited number of major suppliers.

As a result, shocks affecting major cereal exporters can have disproportionate adverse global effects. A production shock in a major exporting country can cascade through the network, reducing trade and raising prices far beyond the initial location of the disturbance. Countries that rely heavily on a limited number of exporters face heightened risks and are especially vulnerable, while those with diversified import links and strong connections to trade hubs are better able to absorb disruptions.

A systemic shock – when multiple exporting countries are affected – can push tens of millions of additional people into undernourishment. Even high-income, food-import-dependent countries are not immune to severe global shocks, although low-income countries suffer the most acute food security consequences.

THE RAPID DYNAMIC ADJUSTMENT OF FOOD AND AGRICULTURAL TRADE TO WEATHER SHOCKS DEMONSTRATES THE RESILIENCE OF GLOBAL MARKETS

Empirical analysis in this report, using high-frequency bilateral trade data, provides further insights into the dynamic adjustment of trade to past weather shocks. The results indicate that weather-related production shocks in cereal-exporting countries lead to immediate declines in exports, followed by recovery within a few months. Most trade impacts are transitory, with flows typically rebounding within six months.

Countries with higher trade connectivity and greater integration into global markets recover more rapidly, while policy interventions – especially export restrictions – tend to deepen disruptions. These findings underscore the adaptive capacity and resilience of global food and agricultural trade, but they also highlight that short-term disruptions can have severe consequences for food security, particularly where safety nets are weak and households spend a large share of income on food. Indeed, recurrent and overlapping shocks may exert persistent food security pressures, especially in vulnerable countries.

FOOD PRICES ARE AN IMPORTANT TRANSMISSION CHANNEL THROUGH WHICH SHOCKS AFFECT FOOD SECURITY

Food commodity prices are inherently volatile, and shocks in major exporters can trigger sharp price increases in global markets, particularly when stocks are low as seen during the 2007–2008 global food price crisis.

In global markets, food commodity prices are determined by many factors, including the fundamental forces of supply and demand, with weather shocks, pests and diseases, and conflicts generating significant price fluctuations. Prices are also influenced by the macroeconomic environment, with monetary policies, exchange rates and speculative activities playing an increasingly important role, along with the agricultural and trade policies of major exporting and importing countries.

Surges in world cereal prices can transmit to domestic markets, resulting in food insecurity and negative nutrition outcomes, particularly in net food-importing developing countries, where cereals make up about 45 percent of calories available for consumption. High prices of cereals reduce the purchasing power of poor households, leading to reduced consumption and diminished diversity and quality of diets. For example, between 2020 and 2022, world price shocks, caused by the novel coronavirus disease (COVID-19) pandemic and the war in Ukraine, were transmitted into domestic markets, with low-income countries experiencing the highest rates of food price inflation, reaching up to 30 percent and placing a disproportionate burden on the poorest households.

THE ROLE OF TRADE POLICIES IN AMPLIFYING OR MITIGATING THE EFFECTS OF SHOCKS

Effective integration in global markets and well-diversified trade connectivity are long-term strategies that can build and strengthen resilience to shocks. A central finding of the report is the critical role of international cooperation. In the event of a shock, non-cooperative responses, such as counter-cyclical trade policies by major players aiming to insulate domestic markets, can put the resilience of global food markets to the test.

For example, export restrictions withdraw supplies from the global market, while import facilitation strengthens demand, further exacerbating the shock's effect on world prices and food security. While such measures are often used in response to domestic food security and political pressures, when they are applied by an increasing number of countries, world prices escalate to levels that render these counter-cyclical trade policies ineffective.

Indeed, analysis shows that in the 2007–2008 global food crisis, insulating policies affecting the global rice market accounted for 45 percent of the increase in the world rice price, while approximately 30 percent of the increase in the world price of wheat can be attributed to changes in border protection rates. International cooperation during the COVID-19 pandemic, where export restrictions were short-lived and food trade remained open, has helped stabilize markets without amplifying price effects.

Food stocks play an important role in resilience, and, in some countries, public stockholding policies may be necessary to support food security, especially when private sector holdings are insufficient. The report shows that large buffer stocks aiming at stabilizing domestic prices have proven to be highly costly and fiscally unsustainable. Maintaining buffer stocks can also distort domestic prices, undermining farmers' incentives and affecting global markets. At the international level, buffer stock schemes have historically failed to deliver sustained price stabilization.

In contrast, smaller emergency food reserves, combined with well-targeted social protection measures, such as cash transfers and food assistance, are more effective in protecting vulnerable populations during crises. At times of shocks, well-targeted safety nets that can be effectively scaled up can mitigate food security impacts without distorting domestic food prices or destabilizing global markets.

RWANDA
Market stalls filled with diverse fresh produce.

PART 1
RESILIENCE AND VULNERABILITY TO SHOCKS IN THE CONTEXT OF FOOD AND AGRICULTURAL TRADE

SUMMARY

Part 1 introduces the concepts of resilience and vulnerability and examines the major global shocks that have affected food and agricultural trade since 2000. Supply- and demand-side shocks are discussed in terms of their frequency, intensity and persistence, framing the concepts of resilience and vulnerability in the context of food and agricultural trade.

KEY MESSAGES

➔ Global food and agricultural markets are exposed to a range of shocks, such as extreme weather events, financial disturbances, geopolitical tensions and conflicts, pandemics and energy price fluctuations. These disruptions can be systemic, affecting many countries and multiple components of the agrifood system at the same time.

➔ Shocks can be transitory or persistent. Supply-side disturbances, such as weather-related events tend to be transitory. Demand-side shocks can be more persistent, leading to structural shifts in food and agricultural markets.

➔ The frequency and intensity of shocks highlight the need to strengthen the resilience of food and agricultural markets. Resilient global food and agricultural markets can absorb disruptions and maintain or quickly restore market equilibrium, ensuring that food continues to move from surplus to deficit regions, contributing to price stability and supporting food security worldwide.

➔ Measures that increase transparency, such as market information systems and coordinated policies that promote open trade, can improve predictability and strengthen the resilience of food and agricultural markets.

Global food and agricultural markets have always been influenced by major shocks that affect production, trade, prices and access to food. These shocks stem from diverse sources, including weather extremes, conflicts, pandemics, financial crises, energy price spikes and abrupt trade policy changes. Episodes such as the 2007–2008 global food price and financial crisis, the novel coronavirus disease (COVID-19) pandemic in 2020–2021, and the 2022 food and energy price surge aggravated by the war in Ukraine illustrate how deeply interconnected global food and agricultural markets transmit disruptions across borders. Agricultural production depends on energy and inputs, such as fertilizers, technology and labour, as well as logistics, stable macroeconomic conditions and effective policies. A disturbance in one sector can rapidly affect food availability and prices worldwide.

At the same time, these historical episodes demonstrate the resilience of global food and agricultural markets. In many cases, global production recovered, trade flows adjusted and markets rebalanced, particularly where trade remained open and policy responses were coordinated. However, even short-term impacts can have significant implications for food security in low-income countries where households spend a large share of their income on food. While shocks often expose structural weaknesses, they have also driven the reforms, investments and cooperation that strengthen long-term stability. Thus, the history of global food and agricultural market shocks is not only a story of vulnerability, but also one of adjustment, recovery and evolving resilience. ■

MAJOR SHOCKS SINCE 2000

Global food and agricultural markets proved relatively resilient to major shocks that have taken place since 2000. For example, during both the global financial crisis of 2009 and the COVID-19 pandemic in 2020 global merchandise trade contracted in terms of volume, while aggregate food and agricultural trade continued on its long-term growth path with markets, in most cases, remaining relatively open and well-supplied, preventing severe and prolonged shortages in most regions (Figure 1.1). However, in terms of value, food and agricultural trade exhibited fluctuations, pointing to significant price effects (see **Part 4**).

Despite major shocks, trade has expanded substantially since 2000. World merchandise export value has nearly quadrupled. Food and agricultural trade have grown even more rapidly, rising from USD 400 billion in 2000 to approximately USD 2 trillion in 2024 (Figure 1.1). Advances in transport technology and infrastructure have lowered transport costs, making trade in food and agricultural products more affordable. At the same time, rising incomes and urbanization have boosted the demand for food, increasing trade between surplus and deficit regions. Since 1995, trade policies and the decline in import tariffs – resulting from the World Trade Organization (WTO) Agreement on Agriculture together with many bilateral and regional trade agreements – have also promoted trade in food and agriculture.

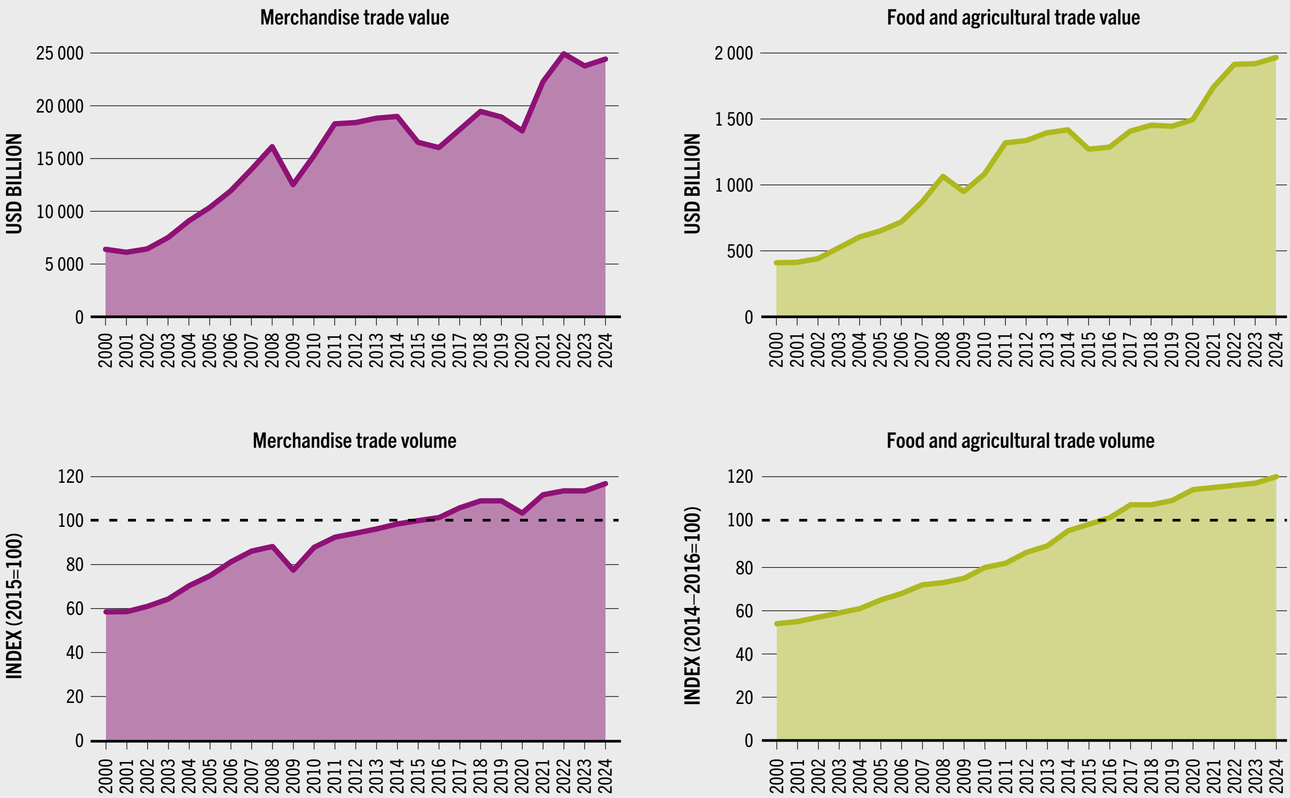
The 2007–2008 global food price crisis

The 2007–2008 global food price crisis was a period of sharp increases in the world prices of staple foods such as wheat, rice, maize and vegetable oils. Between 2006 and mid-2008, global wheat prices more than doubled, while rice prices tripled in some markets.[1] The crisis was driven by a combination of structural vulnerabilities, immediate shocks, and magnifying policy and market responses.[2]

Over time, declining investment in agriculture slowed productivity growth and yield gains, tightening supply relative to the rising demand. At the same time, rising incomes in emerging economies, such as China and India, increased meat and dairy consumption and, in turn, increased the demand for feed grains. Biofuel policies in major economies further reduced availability by diverting crops, such as maize, toward ethanol production, while low levels of global grain stocks left the market highly sensitive to shocks.[3]

These vulnerabilities were triggered by weather-related shocks, such as droughts and floods in Australia and the United States

FIGURE 1.1 GLOBAL MERCHANDISE AND FOOD AND AGRICULTURAL TRADE, 2000–2024

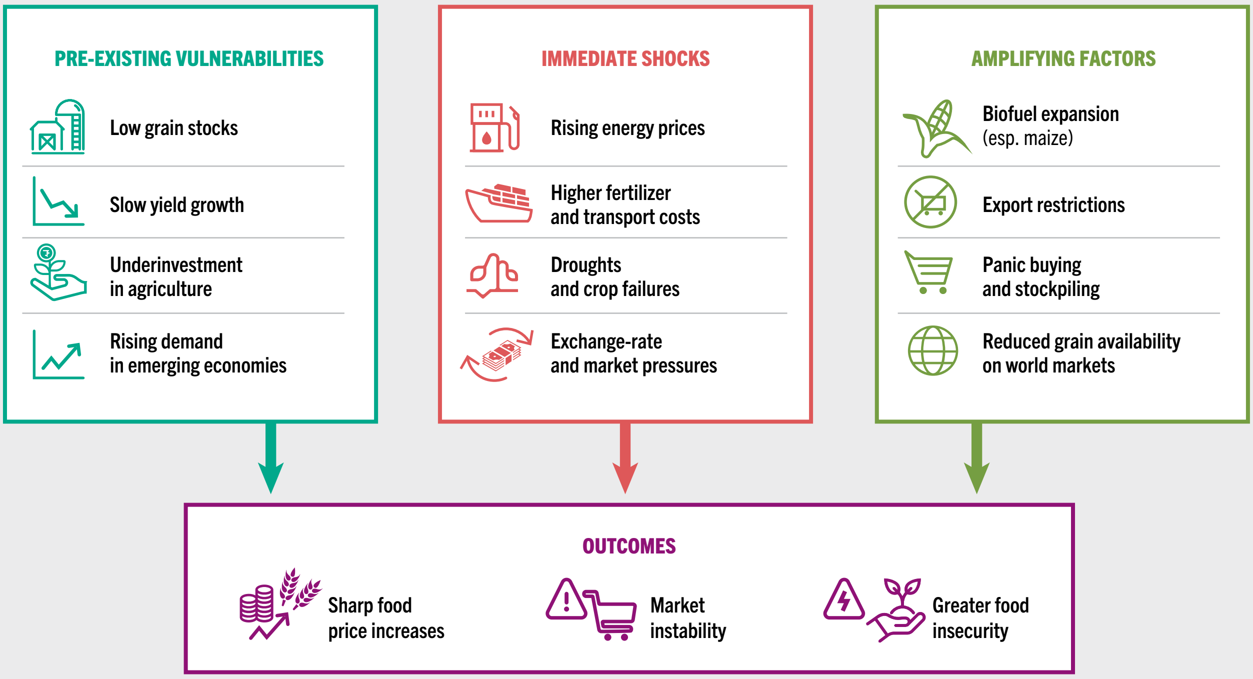


SOURCES: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Crops and livestock products. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TCL. Licence: CC-BY-4.0; FAO. 2026. FAOSTAT: Trade – Trade Indices. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TI. Licence: CC-BY-4.0; WTO. 2026. WTO STATS: International trade statistics. [Accessed on 30 January 2026]. https://stats.wto.org/

of America, rising oil prices that increased production and transportation costs, and expanded biofuel policies (see Figure 1.2). As prices increased, export restrictions imposed by key food-exporting countries intensified supply shortages on world markets. Financial speculation in agricultural commodity futures may have amplified price volatility, while panic buying and stockpiling by importing countries reinforced expectations of scarcity (see Box 4.1 on the financialization of food).[4]

The impact was alarming, with estimates suggesting that over 100 million people were pushed into extreme poverty.[5] Food riots and protests erupted in more than 30 countries, reflecting the vulnerability of urban populations to food price increases. Evidence shows that poor households, which often spend 50–70 percent of their income on food, were disproportionately affected through reduced caloric intake and dietary quality.[6] Governments responded with export bans, emergency food subsidies and expanded safety nets. Following this period, prices declined as the global financial crisis led to weak demand, with the crisis affecting low-income countries and households especially. Rising food prices in 2007–2008 led to an average terms-of-trade loss equivalent to about 0.5 percent of gross domestic product (GDP) across low-income countries, with some countries experiencing far greater impacts.[7]

FIGURE 1.2 DRIVERS OF THE GLOBAL FOOD PRICE CRISIS, 2007–2008



SOURCES: Authors' own elaboration based on Headey, D. & Fan, S. 2008. Anatomy of a crisis: The causes and consequences of surging food prices. *Agricultural Economics*, 39: 375–391. https://doi.org/10.1111/j.1574-0862.2008.00345.x; Timmer, C.P. 2010. Reflections on food crises past. *Food Policy*, 35(1): 1–11. https://doi.org/10.1016/j.foodpol.2009.09.002

The 2011–2012 period of excessive food price volatility

Food prices began rising again in 2010 and continued through 2011–2012. While prices of staple food commodities such as rice, wheat and maize surged, sometimes reaching all-time peaks, this period was also characterized by strong volatility with abrupt increases and decreases in price levels over short periods.[8]

Severe weather events, including floods in Australia and droughts in the Russian Federation, reduced harvests and further tightened global stocks, making markets highly sensitive to shocks. In response to concerns about market transparency and coordination, the Group of Twenty (G20) launched the Agricultural Market Information System (AMIS) in 2011 to share reliable and up-to-date information on crop supply, demand, stocks and export availability to help reduce market volatility (see Box 1.1).[9]

The high and volatile food prices during this period drove millions into extreme poverty, especially in low-income food-importing countries, revealing structural vulnerabilities, including exposure to weather-related shocks, policy reactions such as export restrictions, and insufficient safety nets for vulnerable populations.[10,11] This episode also had lasting welfare impacts, especially for poor, net

BOX 1.1 GLOBAL FOOD COMMODITY MARKETS INTELLIGENCE: A PUBLIC GOOD

The 2007–2008 food price crisis and the extended period of food price volatility that followed underlined the need for reliable and up-to-date information on the supply, demand, stocks and export availability of food staples to guide policy decisions. Low stocks rendered the markets vulnerable to unpredictable disturbances, such as the prolonged Australian drought and the diversion of crops towards biofuel production. At the time, analysts pointed out that global supplies were sufficient to meet food demand without a dramatic increase in prices. However, widespread uncertainty persisted, leading to panic. Exporting countries ultimately responded with a cascade of export bans and taxes, while importing countries lowered trade barriers and, in some cases, imported aggressively (see also **Part 4**).[64]

The Agricultural Market Information System (AMIS), established by the Group of Twenty (G20) under the presidency of France and hosted by the Food and Agriculture Organization of the United Nations (FAO) Markets and Trade Division, provides reliable market information and analysis of market fundamentals, especially stocks for which data is imprecise, to reduce uncertainty.[65] Since its establishment in 2011, AMIS has collected data from major exporting and importing countries on production, consumption, trade and public and private stock levels for key commodities, assessing how much food is actually available globally. By tracking stocks relative to use, AMIS helps identify whether markets are tight or well-supplied. AMIS has become a critical pillar of the global food security architecture, enhancing market transparency and predictability, and promoting policy coordination, helping to prevent policy reactions that can amplify price spikes.[66]

In addition to AMIS, the FAO Markets and Trade Division provides other market intelligence services that support evidence-based policymaking. The FAO Food Price Index tracks monthly changes in world prices for key commodities and is a benchmark for global price developments.* At the domestic level, the Food Price Monitoring and Analysis (FPMA) Tool monitors food prices in low-income and food-deficit countries and provides early warnings of abnormal price increases that may threaten food security.** The FAO Risk Monitor serves as a central hub to coordinate early detection, warning and response to emerging threats, bridging the gap between anticipatory action and emergency response systems. The tool tracks a wide range of risks that are known to drive food insecurity – from weather events like droughts, floods, tropical cyclones and heatwaves, to human-made threats such as conflict and political instability.***

Taken together, these market intelligence functions serve as a global public good by providing timely and reliable information on agricultural markets, prices and food security, thereby supporting more informed policy decisions.

NOTES: * See https://www.fao.org/worldfoodsituation/foodpricesindex/en/ ; ** See https://www.fao.org/giews/food-prices/home/en/
*** See https://riskmonitor.fao.org/

food-buying households. As a result, households adopted short-term negative coping strategies such as reducing meal frequency or switching to cheaper, less nutritious foods.[12]

The COVID-19 pandemic (2020–2022)

The COVID-19 pandemic originated as a public health shock that abruptly transmitted across sectors and borders. In March 2020, the World Health Organization (WHO) officially declared COVID-19 a global pandemic.[13] Governments worldwide implemented unprecedented public health measures, including lockdowns, border closures, social distancing mandates and mass testing campaigns. While these interventions reduced the spread of infection, they also disrupted production, trade and labour markets, with the global economy contracting approximately 3.1 percent in 2020 risking a severe global recession.[14] Agricultural production, food distribution and trade were disrupted in the short term; however, food and agricultural markets proved remarkably resilient.[15]

The global recession resulted in a rise in global undernourishment by approximately 150 million people between 2019 and 2021, while nearly 2.3 billion people experienced moderate or severe food insecurity.[16] Empirical studies show that the pandemic disproportionally affected informal workers and urban populations, leading to a sharp increase in poverty and food insecurity.[17] Income losses and economic uncertainty also led many consumers toward cheaper staples and to reduce purchases of higher-priced foods, such as meat and specialty products, altering the composition of food import demand in many countries.[18]

Large-scale fiscal support programmes and monetary expansion – implemented by governments worldwide – aiming to support demand and counter the severe economic contraction caused by the pandemic, contributed to pushing food prices up resulting in high rates of food inflation globally (see **Part 4**). The synchronized and global nature of the COVID-19 pandemic made it one of the most severe and far-reaching shocks in recent history, underscoring the interconnectedness, but also the vulnerability, of modern economic and social systems.

War in Ukraine (2022–present)

The war in Ukraine disrupted production, exports, energy markets and fertilizer supply, constituting a major shock to global food and agricultural markets. Prior to 2022, Ukraine and the Russian Federation together accounted for a substantial share of global exports of wheat, maize, sunflower oil and fertilizers. In addition, the war blocked Black Sea ports and increased shipping risks and costs.[19]

The initial shock was immediate and severe, particularly in the first half of 2022. Although international cooperation (see Box 3.4) facilitated the partial resumption of exports, helping moderate prices, market uncertainty and high input costs persisted. The impact has been especially significant for low-income net food-importing countries in Northern Africa, the Near East and sub-Saharan Africa that depended on the Black Sea region for grain and fertilizers, which faced higher import bills and domestic food inflation. This, in turn, exacerbated food insecurity and fiscal pressures.[20] Food price increases had an impact on the cost and affordability of healthy diets, particularly in low-income countries, where 72 percent of the population was unable to afford a healthy diet in 2024.[21] Importantly, structural and gender inequalities amplify the effects of food price inflation upon vulnerable groups, who have fewer resources, weaker social protection mechanisms and limited coping options. ■

CONCEPTUALIZING SHOCKS TO FOOD AND AGRICULTURAL MARKETS

Shocks in food and agricultural markets refer to sudden, unexpected disturbances that disrupt the equilibrium of supply, demand, prices and trade flows. They represent short-term deviations from long-term trends that have significant negative impacts on a system, people's state of well-being, assets, livelihoods, safety and ability to withstand future shocks.[22] Such shocks include disasters, extreme weather events, biological and technological events, surges in plant and animal diseases and pests, socioeconomic crises and conflicts. These disruptions may arise from the supply side, demand side, macroeconomic and geopolitical factors or policy decisions (Table 1.1 presents a typology of various shocks).

On the supply side, shocks often stem from extreme weather events, pests and diseases, input price spikes or logistical disruptions. Such shocks reduce production, increase input and distribution costs, therefore raising prices.[23] On the demand side, shocks may derive from income fluctuations, macroeconomic crises, exchange rate depreciation, demographic pressures or consumption shifts. Shocks can be transitory or persistent, ranging from short-term weather-related events to changing dietary preferences that contribute to structural demand pressures in food and agricultural markets.[24] Shocks may also be idiosyncratic or systemic, reflecting localized production shortfalls or widespread global disruptions respectively.[25]

TABLE 1.1 TYPOLOGY OF SHOCKS AND IMPACTS

Shock type	Origin and geographical scope	Frequency	Duration	Potential intensity	Impacts on global markets
Extreme weather events (droughts, floods, heatwaves)	Usually localized and/or regional; global if multiple breadbaskets affected	High (localized), medium (multicountry)	Short to medium	Moderate to high (if crop-specific, can spike prices)	High when affecting major exporters or when stocks are low
Conflicts	Local and/or regional; global if key trade affected or major exporters involved	Medium globally; persistent regionally	Medium to long	Very high domestically; high globally if trade disrupted	Very high if major exporters involved, otherwise regionally concentrated
Pandemics/health crises	Global	Very low	Medium to long	Moderate price effects; high access effects	High due to income and logistics disruptions rather than production losses
Transboundary animal and plant Diseases	Regional to global	Medium	Short to medium	Sector-specific but can be large (e.g. livestock)	Moderate globally; high for specific sectors
Financial / macroeconomic crises	Domestic, regional or global	Medium (domestic), low (global crisis scale)	Medium	High for access through currency depreciation and inflation	High when global (e.g. 2008); moderate otherwise
Energy & fertilizer price surges	Global	Medium	Medium	High across multiple crops	Very high due to input linkages

SOURCES: Authors' own elaboration based on FAO. 2020. *COVID-19 and the risk to food supply chains: How to respond?* Rome.; FAO. 2022. *The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine*. Rome.; Headey, D. & Fan, S. 2010. *Reflections on the global food crisis: How did it happen? How has it hurt? And how can we prevent the next one?* Research Monograph. IFPRI.; Hendrix, C.S. & Brinkman, H.J. 2013. Food insecurity and conflict dynamics: Causal linkages and complex feedbacks. *Journal of Peace Research*, 50(5): 623–639.; Wheeler, T. & von Braun, J. 2013. Climate change impacts on global food security. *Science*, 341(6145): 508–513.; World Bank. 2022. *Food and fertilizer price shocks from the war in Ukraine.* Washington, DC.

Weather extreme events and natural disasters

Extreme weather events, such as droughts, heatwaves, floods and storms, can pose major shocks to food and agricultural markets. They can reduce crop yields and livestock productivity, creating supply shortages that lead to price increases. Since demand for food is relatively inelastic and global trade networks are tightly interconnected, major weather-driven supply disruptions can spread globally, contributing to broader price volatility and food security risks (see **Part 2**). Weather extremes are estimated to have a significant, albeit transitory, impact on food trade (see **Part 3**). Recent research suggests that a 10 percent increase in extreme weather events could result in an approximately 7.6 percent decline in the global trade of maize and a 5.4 percent decline in global rice trade.[26]

Extreme weather events will continue to be a major global challenge this century, with their effects being highly dynamic, often unfolding through cascading processes, affecting economic activity, natural resources, infrastructure, livelihoods and agrifood systems.[27] Exposure varies significantly across regions. Coastal and small island states face heightened risks from stronger storms and sea-level rise, while countries near the equator and in arid and semi-arid regions are vulnerable to heat stress and prolonged drought. Large food-producing countries are also increasingly exposed, with major exporters such as the Black sea region, Brazil and the United States of America facing growing risks from weather-related shocks, including droughts, heatwaves and floods. From 2000 to 2025 approximately 10 687 weather-related disasters were recorded worldwide, highlighting both the scale and recurrent nature of these events.[28]

Economic losses resulting from natural disasters, which include extreme weather events, have risen significantly over recent decades. This is largely attributed to population growth and the expansion of economic activity in areas that are highly exposed to these events, leading to greater concentrations of people, infrastructure and resources in disaster-prone regions.[29] Recent evidence highlights the escalating impact of natural disasters on global agricultural systems, with estimated losses worldwide reaching approximately USD 3.26 trillion over the period 1991–2023.[30]

Geopolitical conflicts

Conflict and geopolitical tensions disrupt agrifood systems simultaneously through production, trade, input markets and household income channels. In contrast to weather extremes, conflict-related shocks have become more frequent and protracted over the past decades. Indeed, the frequency of conflicts worldwide has more than tripled since the early 2000s.[31] Rising geopolitical tensions, driven by the war in Ukraine in 2022 and the escalation of conflict within the Middle East in 2025 and 2026, have reached their highest levels in over two decades, affecting global trade.[32]

The impact of conflicts is multidimensional. Some conflicts remain geographically contained and mainly affect local production, infrastructure and supply chains, potentially leading to food insecurity in the affected areas. Others have additional and more significant effects, triggering trade disturbances through port blockades, export restrictions and energy market disruptions that raise costs, sustaining food inflation worldwide. Disruptions in maritime trade can lead to food and agricultural inputs shortages and higher prices, thus negatively affecting food security (see Box 1.2 on conflict within the Middle East).

Research suggests that trade in services is most vulnerable to geopolitical risks, followed by trade in food and agriculture, while the impact on manufacturing trade is moderate.[33] In addition, the outbreak of conflict can trigger significant trade reallocation among its trade partners. This reallocation effect is estimated at around 11 percent of trade in agricultural goods, and although not permanent, it is projected to persist for approximately 3 to 5 years after the conflict ends.[34] Because conflict-related disturbances are often recurrent, persistent and globally transmitted through trade networks, their cumulative impact tends to be deeper and more systemic than those of short-lived weather shocks, particularly for low-income, net food-importing countries.[35]

Global health crises

Global health crises act as systemic shocks to food and agricultural markets, disrupting both supply and demand. During the COVID-19 pandemic, lockdowns reduced labour availability, lowering output and creating bottlenecks in supply chains.[36] Border restrictions and container shortages raised trade costs even with adequate staple food supplies.[37] Earlier disease outbreaks, such as the 2014 Ebola epidemic in Western Africa, also disrupted food and agricultural markets through labour shortages, border closures and reduced market activity, contributing to higher local food prices and income losses. In some regions, market closures and transport restrictions led to localized price spikes, particularly for perishable products.[38]

Pandemics typically create acute short-term disruptions, such as sudden market closures and logistics breakdowns, followed by medium-term economic effects as incomes, employment and trade recover gradually.[39] While global pandemics are relatively rare, disease outbreaks with economic consequences have become more frequent, posing recurring risks to agrifood systems.[40]

Transboundary pests and diseases

Unlike pandemics that primarily affect supply and demand, animal and plant diseases directly reduce agricultural output. For example, the spread of wheat rusts and desert locust infestations in Eastern Africa damaged staple crop production, threatening local food availability and rural incomes.[41] The African swine fever, which spread across Asia and Europe after 2018, led to the loss of a substantial share of China's pig herd, sharply reducing supply and driving domestic prices upward.[42] By spreading

BOX 1.2 THE IMPACT OF CONFLICT WITHIN THE MIDDLE EAST: ENERGY AND FERTILIZER MARKETS AND MARITIME ROUTES

Conflict within the Middle East is having an impact on food security, trade and agriculture by placing renewed pressure on one of the world's most important energy and shipping chokepoints, the Strait of Hormuz.* Recent FAO analysis indicates that the 2026 shock has intensified as conflict in and around the Gulf has disrupted shipping routes, increased risks in energy and fertilizer markets and heightened vulnerabilities for food-import-dependent countries across the Middle East.[67] The World Trade Organization (WTO) also notes that conflict is further weakening an already fragile global trade outlook.[68]

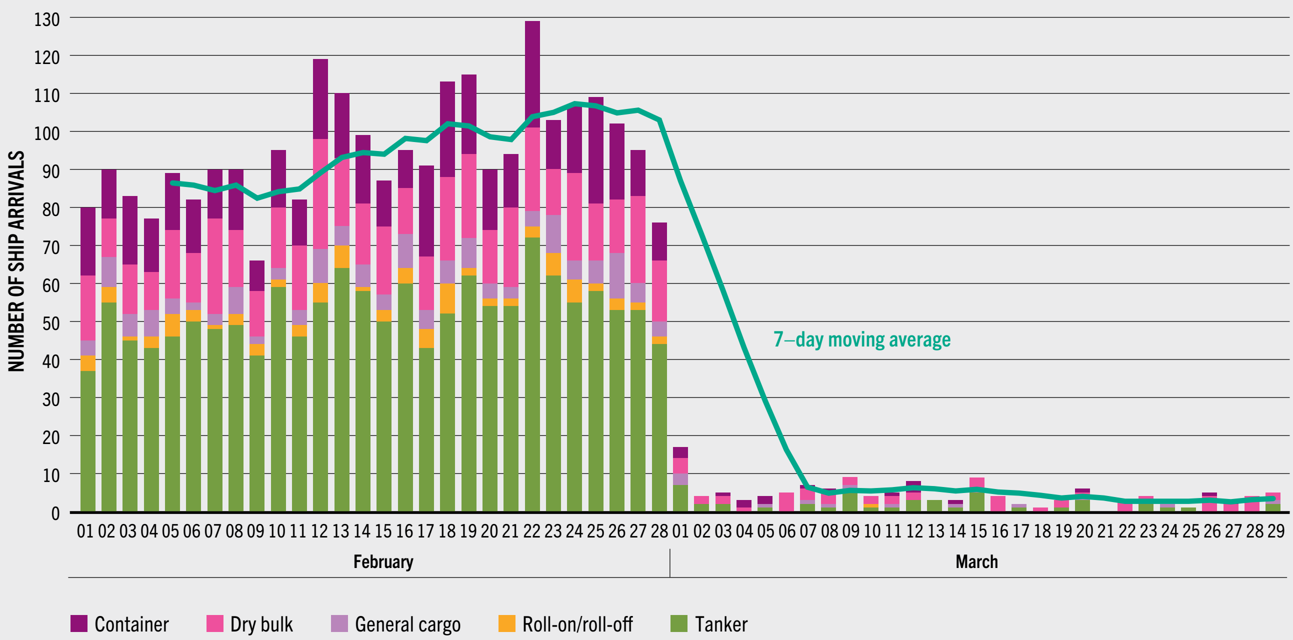
The Strait of Hormuz remains a critical chokepoint in global energy trade, accounting for approximately 27 percent of world oil exports, 20 percent of liquefied natural gas exports and between 20 and 30 percent of fertilizers, depending on the specific product. Since conflict began, shipping through the Strait has reportedly fallen by almost 100 percent, highlighting the scale of the disruption and the severity of risks facing maritime transport (see the Figure).

These developments echo earlier disruptions following the war in Ukraine, which exposed the structural vulnerability of global agriculture to fertilizer shocks. The war drove fertilizer prices to record highs by disrupting exports from the Russian Federation and Belarus, key suppliers of urea, phosphate and potash, while Black Sea disruptions and export restrictions by key producers further tightened supply.

Although many large importers were eventually able to find alternative suppliers and global prices fell from their 2022 peaks, fertilizers remained costly and less accessible in many low- and middle-income countries, especially in sub-Saharan Africa.[69] Fertilizer shortages and higher energy prices are central channels through which crisis within the Middle East threatens food production and agrifood systems globally. Higher fuel prices raise the costs of irrigation, mechanization, transport and food processing, while disruptions in fertilizer trade can reduce farm productivity and yields.[70] Disruptions to maritime transport, port operations and logistics can reduce food availability, delay shipments and increase import costs. These pressures are particularly significant in the Near East and Northern Africa, where many countries rely strongly on external markets for cereals, vegetables oils and other basic food products.

NOTE: * The Strait of Hormuz, located between Oman and the Islamic Republic of Iran, connects the Persian Gulf with the Gulf of Oman and the Arabian Sea. The strait is deep and wide enough to handle the world's largest crude oil tankers, and it is one of the world's most important oil choke points.

FIGURE ARRIVALS OF SHIPS THROUGH THE STRAIT OF HORMUZ



SOURCE: Authors' own elaboration based on IMF. 2026. Portwatch: Trade disruptions in the Strait of Hormuz. Washington, DC. [Cited 10 April 2026]. https://portwatch.imf.org/pages/cc317ba850e34c4dadbead6f7b336fb1

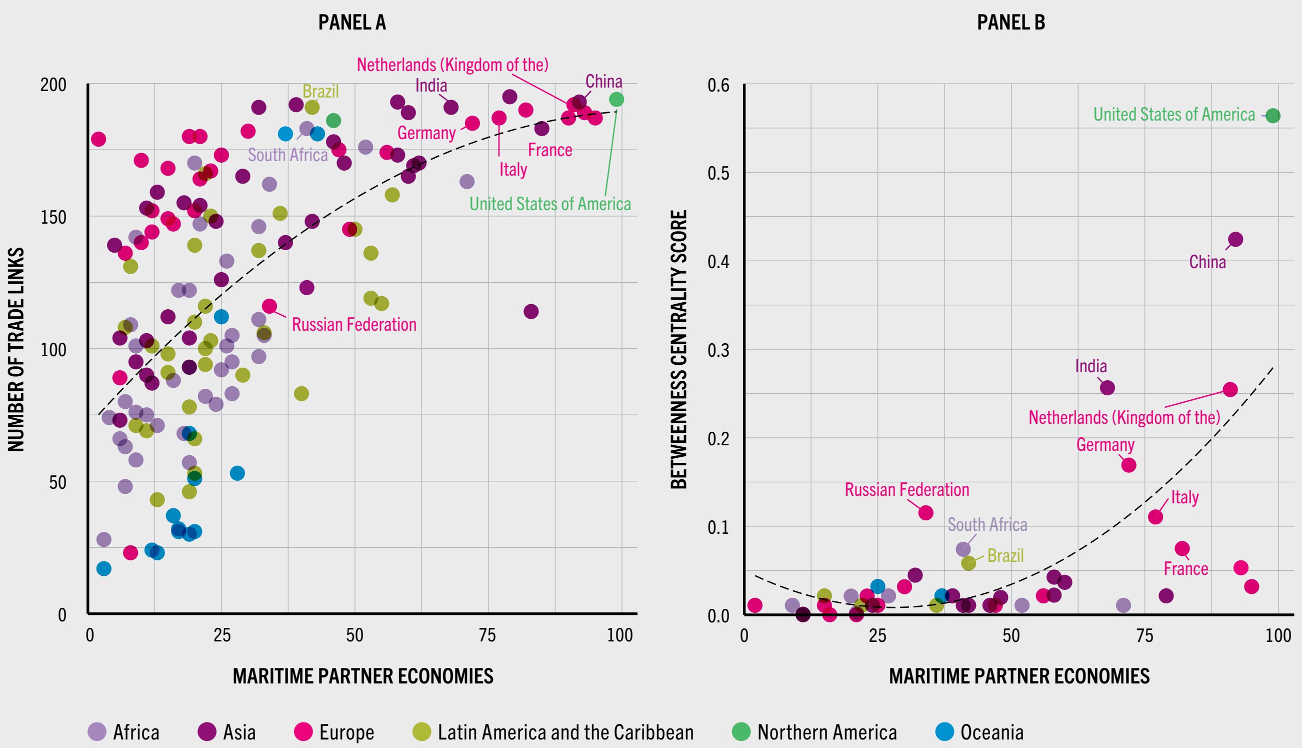
BOX 1.2 (Continued)

Trade effects can be substantial. Instability in major maritime corridors raises freight, insurance and transaction costs and contributes to delivery delays and uncertainty for exports and importers. The United Nations Conference on Trade and Development (UNCTAD) notes that rerouting and insecurity in major shipping corridors have contributed to volatility in freight markets for grain, fertilizer and other commodities.[71] The WTO projects baseline world merchandise trade growth of 1.9 percent in 2026, but notes that this could fall to 1.4 percent if conflict within the Middle East results in persistently higher oil prices.[72]

Most countries with a central role in the agrifood trade network are located on major trade routes, indicating the vulnerability of the network to any disruptions along these routes. Countries with more agrifood trade links tend to be connected with more maritime partner economies (see the Figure below, **Panel A**). Core agrifood trading countries are especially connected with more maritime partner economies than countries in the network periphery (Figure below, **Panel B**) and their container import dwell time tends to be lower, indicating higher port efficiency. Any disruptions along food and fertilizer trade routes affecting the productivity, connectivity or logistics of these countries can lead to cascading effects in the entire agrifood trade network (see **Part 2**).

Overall, these developments are adding pressures to agrifood systems by increasing import costs, raising agricultural input prices, and creating greater uncertainty in regional and global trade. Countries that are highly dependent on food imports and face limited fiscal space would be particularly vulnerable to these effects.

FIGURE TRADE ROUTES, TRADE PERFORMANCE AND AGRIFOOD TRADE NETWORK CENTRALITY



NOTES: Countries with many maritime partner economies tend to have many agrifood trade links (**Panel A**). Especially countries with a central role in the agrifood trade network in terms of connectivity and trade volume (as measured by the betweenness centrality) are linked to many maritime partner economies (**Panel B**). In **Panel B**, only countries with non-zero betweenness centrality are shown.

SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Detailed trade matrix. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TM. Licence: CC-BY-4.0; World Bank. 2026. Logistics Performance Indicators (2.0). [Accessed on 19 May 2026]. https://lpi.worldbank.org/en/home across borders, transboundary pests and diseases can severely disrupt food and agricultural markets, triggering sanitary and phytosanitary restrictions, disrupting cross-border trade flows and generating sharp price and income effects.[43] Especially in low-income countries, where livelihoods heavily depend on crops and livestock, outbreaks can simultaneously reduce income and food access, exacerbating food insecurity.

Transboundary animal and plant pests and disease shocks can range from short-term outbreaks lasting months, such as localized avian influenza incidents, to multiyear structural impacts, as seen with African swine fever, where herd rebuilding and market adjustment were prolonged.[44] Their frequency has increased in recent decades due to an intensification of agriculture, weather extreme events and expanded global trade, which facilitates the rapid spread of pathogens across borders.

Financial and macroeconomic crises

Financial and macroeconomic crises disrupt the broader economic environment in which food is produced, traded and consumed. Exchange rate depreciations raise the domestic price of imported food and agricultural inputs such as fuel and fertilizer, while high inflation reduces real household incomes. At the same time, financial instability and tighter lending conditions constrain access to credit for farmers, traders and food processors, weakening production and supply chains. For example, during the global financial crisis in 2009, income contractions, reduced trade finance and exchange rate volatility affected both food import capacity and export revenues, with domestic food prices rising in several countries despite world prices falling from their peak.[45]

These crises typically involve acute short-term macroeconomic shocks followed by slower, multiyear recoveries, particularly when banking or sovereign debt problems restrict fiscal space and government spending. Historically, systemic banking and currency crises have reoccurred regularly, especially in emerging and developing economies.[46] Low-income, food-import-dependent countries are particularly vulnerable when currency depreciation coincides with high world prices, allowing financial instability to quickly translate into negative food security outcomes.

Energy and fertilizer prices

Energy and fertilizer price shocks are major drivers of instability in food and agricultural markets as they directly affect production costs, transport expenses and ultimately consumer prices. Modern agriculture is highly energy intensive. Fuel powers farm machinery and irrigation, natural gas is a key input for nitrogen fertilizer production, and energy costs shape processing, storage and distribution. When energy prices increase, as seen during the 2007–2008 world food price crisis and again in 2022 following the war in Ukraine, fertilizer prices often rise sharply, increasing input costs worldwide (see Box 1.2).[47]

In terms of frequency, energy and fertilizer price shocks are often linked to geopolitical tensions or global demand cycles. Their intensity can be severe. In 2022, world fertilizer prices more than doubled from pre-pandemic levels, while energy prices hit multiyear highs. As such, these shocks fuel food price inflation eroding consumers' real incomes and increasing food insecurity.[48]

Emerging technology disruptions and risks

Technological developments play a central role in shaping food and agriculture. Advances in agricultural technologies, such as improved seed varieties, precision farming, digital monitory systems and automation, have contributed to higher yields, improved resource efficiency, and have strengthened resilience to weather extremes and market risks.[49] Innovation in storage, transportation and logistics have facilitated trade, reducing transaction costs and expanding market access. Tools such as data analytics, satellite imagery, blockchain and e-commerce platforms strengthen supply chain coordination and transparency, while digital financial services expand access to credit and insurance.[50]

At the same time, technological disruptions can create a distinct category of shocks to food and agricultural markets. For instance,

BOX 1.3 GLOSSARY

Disaster risk: The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.

Shock: A short-term deviation from long-term trends that have substantial negative effects on a system, people's state of well-being, assets, livelihoods, safety and ability to withstand future shocks.

Vulnerability: The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

SOURCES: UNDRR. 2017. The Sendai Framework Terminology on Disaster Risk Reduction. "Disaster". In: *UNDRR*. Geneva, Switzerland. [Cited 18 February 2026]. https://www.undrr.org/terminology/disaster; FAO. 2021. *The State of Food and Agriculture 2021 – Making agrifood systems more resilient to shocks and stresses*. Rome. https://doi.org/10.4060/cb4476en

cyberattacks, systems failures or breakdowns in digital infrastructure can interrupt production, processing and distribution, with impacts that rapidly spread along supply chains.[51] For example, in 2021, the ransomware attack on JBS S.A., a multinational meat processing company, temporarily disrupted meat processing operations in several countries, highlighting vulnerabilities in digitally interconnected agrifood systems.[52]

As the digital interdependence of agrifood systems has increased, exposure to cyber risk has grown. Food trade relies on interconnected digital infrastructure, including electronic customs systems, port management platforms, digital certification systems and automated processing technologies. Supply chains of perishable foods, such as fresh produce, dairy, meat and fish, are especially vulnerable to even short-term interruptions arising from cyberattacks.[53] ■

DEFINING VULNERABILITY AND RESILIENCE IN THE CONTEXT OF TRADE

Broadly, in social sciences, the concept of **vulnerability** refers to the propensity of a subject to be affected by a shock that negatively impacts the state of well-being. In contrast, **resilience** refers to the capacity to withstand and recover from shocks and stressors, preventing their adverse impacts from lasting over time.[54]

Within the United Nations system, efforts to strengthen disaster resilience are coordinated by the United Nations Office for Disaster Risk Reduction (UNDRR), which led to the development of the Sendai Framework for Disaster Risk Reduction 2015–2030. The Sendai Framework marked an important milestone by shifting the global approach from managing disasters after they occur to proactively reducing disaster risks. It also established a common set of definitions and concepts, including resilience and vulnerability, that guide policy and practice across disaster risk reduction efforts (Box 1.3).[55]

In the context of agrifood systems, FAO defines resilience as "the capacity over time of agrifood systems, in the face of any disruption, to sustainably ensure availability of and access to sufficient, safe and nutritious food for all, and sustain the livelihoods of agrifood systems' actors".[56] The Organization also notes that, to be resilient, agrifood systems "must have all of the five resilience capacities – prevent, anticipate, absorb, adapt and transform – in order to continue functioning in the presence of shocks that are not completely predictable".[57]

The global trading system is a central pillar of food security, serving as a key channel for pooling and distributing food across regions. In the context of trade, the global food and agricultural market is deemed resilient when, despite shocks or periods of stress, it can maintain or swiftly regain its equilibrium and continue to fulfil its core function of moving food and agricultural products from surplus to deficit areas, thus promoting food security and nutrition globally.

In this context, resilience identifies with the buffer capacity of the global food and agricultural market to absorb shocks and limit the incidence of food price spikes. The global market's pooling mechanism can ensure that region-specific shocks partially offset one another at the worldwide level. This makes trade a powerful engine to even out supply fluctuations caused by local shocks across the globe or significantly mitigate the impacts of global disruptions. At the same time, global market vulnerability reflects the likelihood that shocks disrupt trade flows, potentially limiting the movement of food and agricultural products, generating food price volatility, and posing risks for global food security.

Several key factors shape the resilience of global markets, including trade intensity, the number, structure and diversity of existing trade links and their adaptability, and the policy environment influencing how food flows across borders (see also **Part 2**). Trade intensity reflects large trade volume, a high number of participants and an efficient price-discovery function. In contrast, markets characterized by relatively low trade volumes and a low number of transactions can be susceptible to substantial price changes following a shock. For example, the global rice market is characterized by relatively low trade intensity, with a small share of global rice production being traded internationally.[58] In 2024, about 10 percent of global production was exported compared with 25 percent for wheat (see also **Part 4**).

Recent research shows that trade connectivity, measured by the number of trade links between countries, is an important indicator of resilience.[59] The nature of the distribution of these links is also important (see **Part 2**). A denser and more interconnected global market has strong food pooling and distributing mechanisms, increasing its resilience to shocks.

Global markets can also serve as a channel for the diffusion of shocks with trade connectivity playing a significant role in determining the resilience and vulnerability of countries. Only a few countries source a wide variety of food and agricultural products from many suppliers – a strategy that enhances resilience. The capacity of countries to quickly reorganize the network of their trade partners and routes when one or multiple shocks occur is also recognized as an important resilience-building factor (see **Part 3** on the transient effect of shocks on trade).[60]

In some cases, countries rely on a small number of trade partners, leaving them exposed to disruptions affecting exporters.[61] For example, following the outbreak of the war in Ukraine in 2022, markets responded to uncertainty, resulting in a substantial rise in world wheat prices – FAO's Food Price Index peaked at 159.3 in March 2022. Yet, the degree of vulnerability to this shock varied across countries. While many countries imported wheat from Ukraine and the Russian Federation, not all were equally vulnerable. Those with high volume import needs, few trade partners and limited financial resources were most exposed to this shock (see Box 1.4).

Policy responses to shocks can boost resilience. According to the WTO, most trade policies implemented upon the outbreak of the COVID-19 pandemic were trade-facilitating, which helped limit disruptions.[62] As a result, the effect of the pandemic upon global trade was short-lived, with trade flows decreasing in April and May 2020 and resuming as early as June 2020.[63] At the same time, policies can weaken the resilience of global »

BOX 1.4 VULNERABILITY OF WHEAT TRADE ROUTES TO THE WAR IN UKRAINE

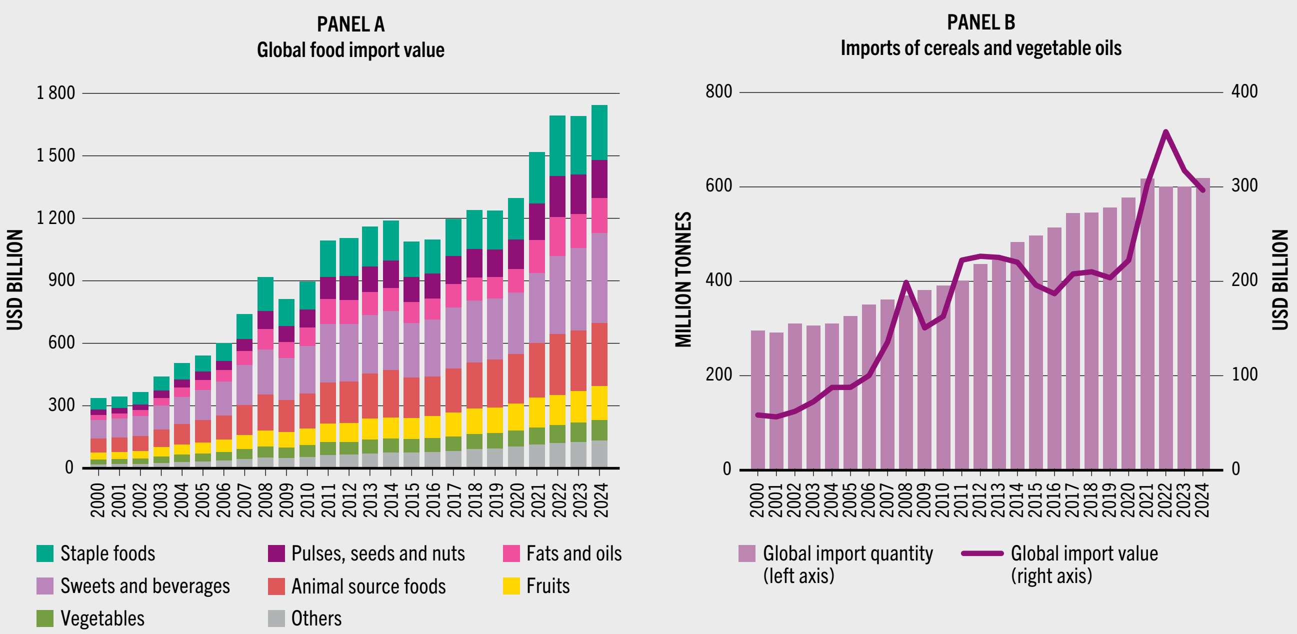
At the onset of the war in Ukraine in February 2022, both Ukraine and the Russian Federation were key exporters of food and agricultural products, notably wheat, barley, maize, rapeseed, rapeseed oil, sunflower seed and sunflower oil. The Black Sea route was a well-established trade corridor. Many countries in the Near East and Northern Africa relied heavily upon it to meet their import needs due to geographical proximity that translates into lower shipping costs. In 2021, a total of 40 net food-importing countries sourced more than 30 percent of their wheat imports from Ukraine and the Russian Federation.[73]

Research examining the vulnerability to wheat trade disruption caused by the war in Ukraine highlights the disparity between countries' ability to tap into the global wheat market. Countries with diversified trade networks and stronger financial resources, such as Oman and Saudi Arabia, compensated for disruptions by sourcing wheat imports from other suppliers, such as Australia, India and the United States of America.

In contrast, Lebanon, Libya, Mauritania and Yemen were more dependent on Ukrainian wheat imports. Some countries, including Egypt, Lebanon and Tunisia, were initially constrained in changing trade partners but had sufficient stocks to meet immediate needs. In other cases, particularly Libya and Mauritania, estimated wheat import shortfalls far exceeded existing inventories. This illustrates that a diverse trade network was important to withstand the uncertainties associated with this shock.[74]

The halt in maritime exports from Ukraine lasted until late July 2022, when the Initiative on the Safe Transportation of Grain and Foodstuffs from Ukrainian Ports, and the Memorandum of Understanding on promoting Russian food products and fertilizers to the world markets entered into force (see also Box 3.4).* Wheat prices, which had increased drastically upon the outbreak of the war, were estimated to have declined by 7.9 percent upon the signature and implementation of the agreements.[75]

FIGURE GLOBAL FOOD IMPORT BILL AND GLOBAL IMPORTS OF CEREALS AND VEGETABLE OILS, 2000–2024



SOURCES: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Crops and livestock products. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TCL. Licence: CC-BY-4.0.

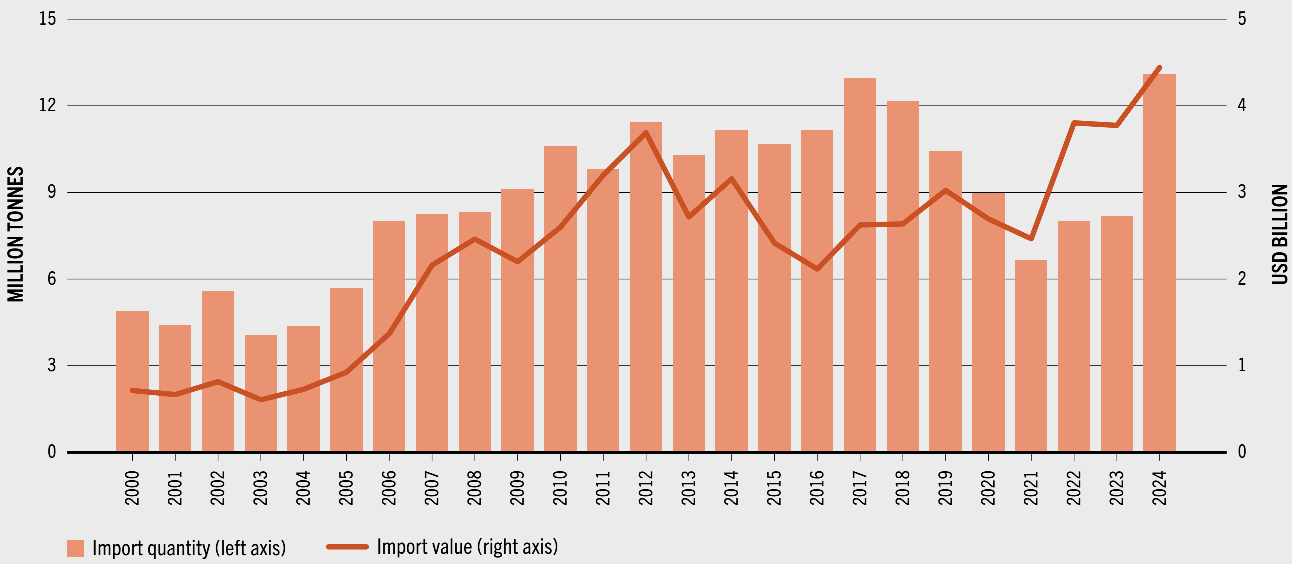
BOX 1.4 (Continued)

For low-income food-deficit countries, where food often represents a substantial share of total imports and where foreign exchange reserves are limited, sudden price surges can generate acute balance-of-payments pressures and fiscal strain. The global food import bill increased significantly in 2008 and neared the USD 2 trillion mark after the outbreak of the war in Ukraine in 2022 (see the first Figure, **Panel A**). Notably, this occurred due to high prices without matching increases in global quantities traded. Global imports of cereals and vegetable oils and fats increased only gradually up to 2021 and decreased in 2022 and 2023. Nevertheless, the relative import bill for these items has increased sharply since 2020 (see the first Figure, **Panel B**).

Rising import bills can constrain governments' ability to finance social protection or agricultural investment, thereby compounding both short-term access constraints and longer-term structural vulnerabilities. Consequently, world price surges may transmit rapidly into food insecurity in net food-importing economies, particularly where safety nets and macroeconomic buffers are weak. Countries' ability to absorb a growing food-import bill varies greatly. In Egypt, for instance, food subsidies are an important pillar of the national food security strategy. These subsidies benefit most of the population and make up a significant share of the government's budget. Egypt was exposed to the shock posed by the war in Ukraine directly, as it sourced a significant share of its wheat and all its sunflower seed oil imports from Ukraine and the Russian Federation and indirectly through higher global prices even after shifting suppliers.[76] Indeed, the value of Egypt's wheat imports expanded exponentially between 2021 and 2022 (see the second Figure).

NOTE: * The Initiative on the Safe Transportation of Grain and Foodstuffs from Ukrainian Ports, commonly referred to as the Black Sea Grain Initiative, and the Memorandum of Understanding between the Russian Federation and the Secretariat of the United Nations on promoting Russian food products and fertilizers to the world markets were in place between July 2022 and July 2023.

FIGURE WHEAT IMPORTS BY EGYPT, 2000–2024



SOURCES: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Crops and livestock products. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TCL.

BOX 1.5 THE ROLE OF TRADE IN DIVERSIFYING SOURCING STRATEGIES FOR AGRIFOOD SYSTEM RESILIENCE

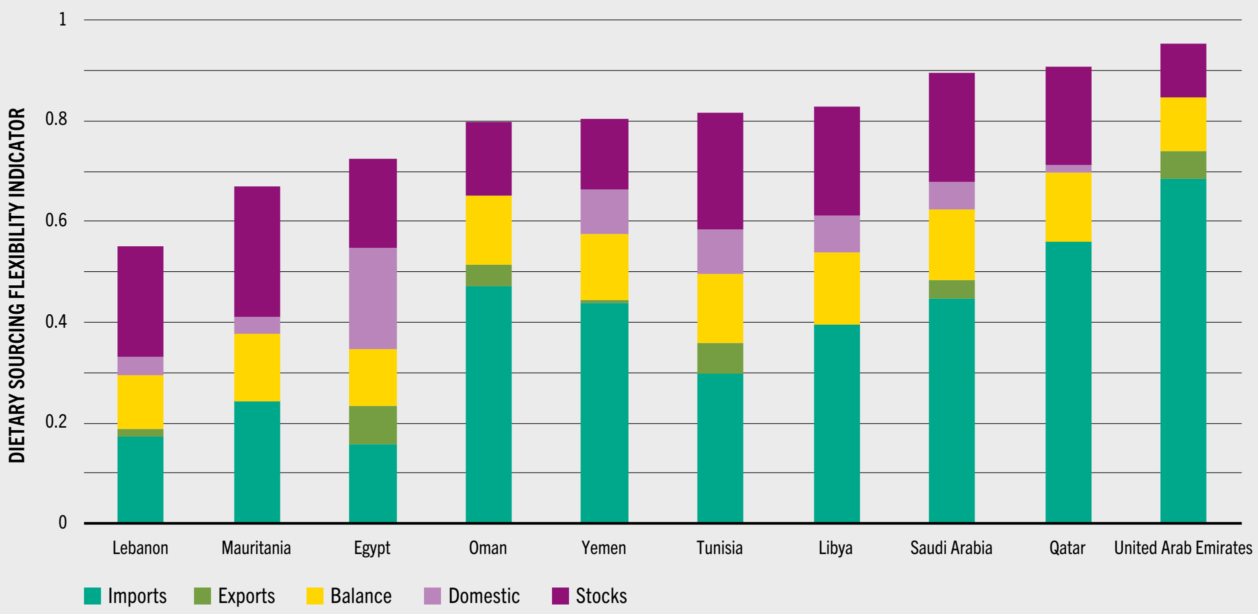
The Dietary Sourcing Flexibility Indicator (DSFI), developed by FAO, measures a country's ability to absorb shocks by capturing all pathways through which a unit of food – expressed in nutritional terms such as kilocalories – can reach consumers. Higher scores reflect greater diversification across sourcing channels and stronger absorptive capacity.

The DSFI can be decomposed into five subindicators capturing diversity in production for the domestic market, exports (as potential backup supply), stocks and imported commodities (including diversity of import partners) alongside a fifth component reflecting the overall balance between domestic and external sourcing. Together, they sum to a DSFI value ranging between 0 and 1.

The DSFI captures the central role of trade in resilience: diversified imports across countries and regions expand the range of supply pathways available, reducing exposure to disruptions affecting domestic production or any single partner. At the same time, the DSFI shows that self-sufficiency alone cannot ensure resilience, as reliance only on domestic production leaves countries vulnerable to domestic shocks.

The Figure shows that countries with similar DSFI levels, even within the same region, often rely on quite different combinations of sourcing channels rather than following a single model of resilience. Trade-related components (imports, exports and the balance between domestic and external sourcing) consistently lift DSFI levels, underscoring the importance of trade as a resilience strategy. Qatar and the United Arab Emirates derive their flexibility primarily from a wide range of import partners, rather than from domestic production. Egypt, despite a low diversification on the import component, reaches a sound level of resilience by relying on a stronger production base (both for domestic and export markets) and stocks. Lebanon or Mauritania, by contrast, exhibit lower resilience in supplying

FIGURE COMPOSITION OF THE DIETARY SOURCING FLEXIBILITY INDICATOR FOR KILOCALORIES ACROSS SELECTED COUNTRIES, 2023



SOURCE: Authors' own elaboration based on FAO. (forthcoming). FAOSTAT. Licence: CC-BY-4.0.

BOX 1.5 (Continued)

kilocalories due to limited diversification on both domestic and import sides, compensated only in part by relatively large stock buffers. The balance component (cyan) varies little across these countries, reflecting a broadly similar – and consistently meaningful – mix of domestic and external sourcing; most cross-country variation arises instead from the diversity of imported commodities and trading partners (dark blue).

Empirical validation of the DSFI against historical supply disruptions identifies a critical threshold around 0.6 for kilocalories, below which countries face a non-trivial risk of sizeable supply shortfalls. The implication of the Figure is striking in this light: stripping out the contribution of imports to diversity would push every country shown below the 0.6 threshold. At the same time, trade is most effective when complemented by domestically available supply (as shown by the consistent contribution of the "balance" component), which provides a buffer against disruptions in international markets.

Recent crises reinforce the case for diversification. Reliance on a narrow set of suppliers – such as the case of Egypt sourcing most of its wheat from Ukraine right before the war – can amplify exposure to shocks, while diversified trade and stocks provide critical buffers against supply disruptions. In this context, the DSFI provides a valuable tool for tracking how countries adopt different diversification strategies and for guiding policymakers in assessing countries' sourcing pathways.[77,78,79,80,81]

SOURCE: Authors' own elaboration based on FAO. (forthcoming). FAOSTAT. Licence: CC-BY-4.0.

» markets. During the 2007–2008 global food price crisis, export restrictions imposed by several major rice exporters contributed to significant increases in the world price of rice (see **Part 4**).

The definition of resilience developed in this report is specific to the context of trade and extends to countries that participate in global food markets. Trade provides consumers worldwide with sufficient, safe and nutritious food and generates income and employment for farmers. However, shocks that disrupt trade flows can affect exporting and importing countries, with negative implications for farm incomes and food security. Accordingly, the analysis focuses on assessing the resilience of global food markets and countries in terms of trade flows affected, the impact on world and domestic food prices and food security, and examines trade policies that can strengthen the buffer capacity of global food trade.

Trade plays a vital role in agrifood systems by linking all segments of agricultural and food value chains across countries. It contributes to food security and nutrition, supports economic development, and interacts with society and the environment. In this sense, resilient global food markets contribute towards the resilience of agrifood systems as they strengthen their overall capacity to absorb, adjust and respond to disruptions. This report complements the earlier work of *The State of Food and Agriculture 2021*, which examined the resilience of national agrifood systems, assessed their capacity to absorb shocks, including on the basis of the diversity of domestic production and trade, and provided policy guidance to enhance the resilience of domestic food supply chains, rural livelihoods and households (see Box 1.5). ■

TÜRKIYE
A freight ship transporting cargo containers.
© istock.com/bfk92

PART 2
GLOBAL TRADE NETWORK – ASSESSING VULNERABILITY TO SHOCKS

SUMMARY

Part 2 examines the resilience and vulnerability of global wheat, maize and rice trade networks in the face of shocks. The analysis focuses on the immediate effects of two major production shock scenarios on food security and underscores the importance of international cooperation in mitigating their effects and ensuring stable food supplies.

KEY MESSAGES

➔ Extreme weather events and other shocks can lead to sudden shortfalls in food production and increase hunger. Trade can contribute to food security through increased imports. Better connectivity within the trade network strengthens this buffering capacity – countries that can source food from more trade partners are more resilient to shocks.

➔ Trade can also transmit external shocks to domestic markets, increasing countries' vulnerability. The specific mechanisms and impacts on food security depend on various factors, including the nature of the initial shock, the structure of the global trade network, levels of connectivity between countries and trade policy responses.

➔ Over the last three decades, the global network of aggregate food and agricultural trade has expanded substantially, and more countries have become increasingly interconnected through trade, improving their resilience to shocks. However, the trade networks for cereals, which are critical for food security, remain concentrated, with a few major exporters supplying many countries. This lessens resilience to shocks and exposes countries to increased vulnerability.

➔ A major shock upon a key exporter can cascade throughout the trade network. A food system shock affecting multiple countries simultaneously can evolve into a global food crisis. In both cases, the effects on global food security may be severe, pushing tens of millions of people into undernourishment. Although net food-importing developing countries are most vulnerable, high-income importers are not immune to major shocks.

➔ How countries respond to shocks affects the resilience of global food markets. When major producers implement export restrictions to protect their markets, they transfer instability to global markets and contribute to increased food insecurity worldwide. In contrast, sustaining exports can reduce the adverse effects of shocks globally. Food inventories contribute to resilience.

➔ Interconnected trade networks demonstrate that no country in the world can achieve food security and support healthy diets independently. Over the long term, trade can enhance productivity, facilitate technology and knowledge spillovers, and allocate natural resources more efficiently. International cooperation is essential for reaping the long-term benefits of trade and for mitigating the effects of shocks, ensuring food security for all and at all times.

Shocks such as weather extremes, conflicts and economic downturns are major threats to food security, especially in vulnerable countries that are already strained by widespread poverty and income inequality.[1,2] Among these shocks, weather extremes occur frequently and most directly affect agriculture, making them one of the leading causes of severe food crises (see **Part 1**).[3,4]

Weather is a primary driver of agricultural productivity, and climatic conditions define agricultural production possibility frontiers, shaping agriculture and landscapes around the world. Different climates nourish different crops, but extreme weather events can destroy harvests and planting areas, with disastrous effects on food production and food security. It is estimated that disasters, including hydrometeorological, geophysical, biological and environmental hazards, have inflicted USD 3.26 trillion in agricultural losses between 1991 and 2023. This translates to an average USD 99 billion in agricultural production lost every year, with cereal crops being most affected, followed by fruits and vegetables. Production losses resulting from disasters correspond to a reduced availability of 320 kcal per person per day globally.[5]

Trade can buffer the effects of shocks and domestic production shortfalls on food security. At the same time, trade can also transmit shocks from the global market to domestic economies. Whether trade acts as a buffering mechanism or transmission channel depends on whether the shock is localized or systemic, the trade intensity of global food markets, their structure, the connectivity among countries and their trade policies. ■

THE EVOLUTION OF FOOD TRADE NETWORKS AND THEIR ROLE IN THE CONTEXT OF SHOCKS

To enable economic growth, ensure food security, promote healthy diets and prevent food shortages in times of shocks, most countries balance their own production with diverse food imports from a variety of trade partners. This is reflected in the evolution of the global food and agricultural trade network. For over thirty years, this network has kept expanding. Countries have increased their connectivity, forming more trade links among each other, facilitated by lower trade costs and efficiency gains through leveraging comparative advantages. These developments have increased overall trade, resulting in lower food prices and greater diversity in food supply (see also **Part 4**).[6,7]

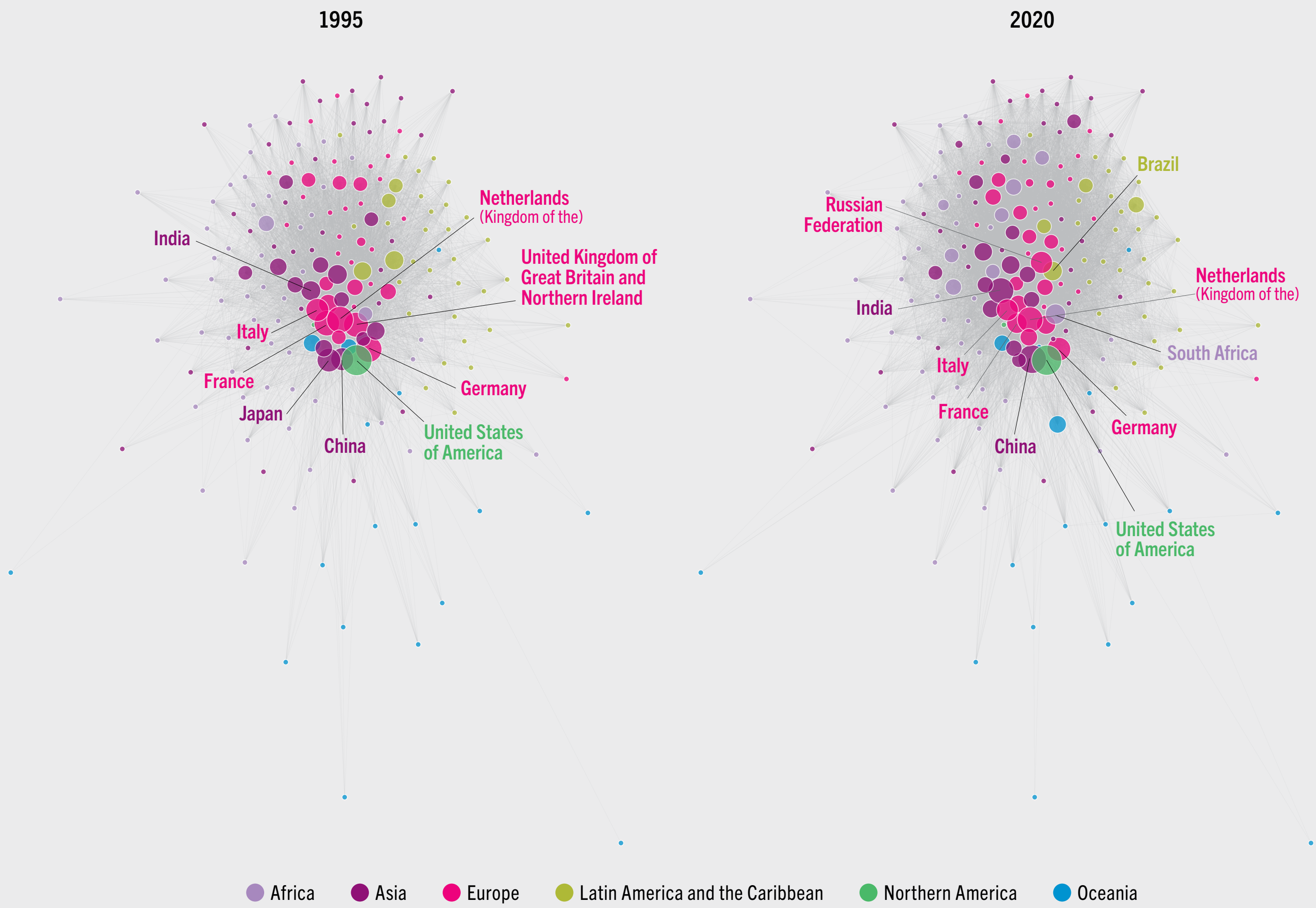
The global food and agricultural trade network

Between 2000 and 2024, the volume of food and agricultural trade more than doubled, reaching a total value of about USD 2 trillion. This growth was also driven by the establishment of new trade relationships. In 2023, about 60 percent of all possible bilateral trade links between countries were used to exchange food and agricultural products, up from 47 percent in 2000.[a] As the global food and agricultural trade network became more dense, its structure also evolved (see Figure 2.1).[b] In 1995, the network was dominated by a small number of countries that accounted for a substantial share of global trade. These countries, including the United States of America and several European countries, held central positions in the network, as most trade

a Estimates of network density are based on the undirected trade network, i.e. irrespective of whether trade links are mutual or for export or import only. Depending on calculation method and underlying data sources and handling, estimates can differ in magnitude across studies, while results, for example on the evolution of connectivity over time or differences in connectivity across commodities, remain qualitatively consistent.

b For the analysis, the most recent and reliable data are used. For trade values and volumes, the most recent year available is 2024 (Figure 2.3). For the analysis of trade links, 2023 data are considered more reliable. The network charts (Figure 2.1 and Figure 2.5) are based on 2020 data to represent the networks as they had fully evolved. In general, the trade network adjusts only slowly without sudden changes.

FIGURE 2.1 GLOBAL NETWORK OF FOOD AND AGRICULTURAL TRADE, 1995 AND 2020



NOTES: The circles denote countries. Large circles are countries with high connectivity and high trade intensity, that is major exporters, importers or trade hubs. When these countries are located in (outside) the core of the network, the network is more centralized (decentralized). Between 1995 and 2020, countries moved away from the centre and the network became less centralized. The number of trade links and network density increased.

SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Detailed trade matrix. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TM. Licence: CC-BY-4.0.

would flow through them. By 2020, the number of major players had increased markedly as emerging economies, such as Brazil and China, expanded their trade, while their relative dominance in the network diminished. Instead, regional hubs emerged, connecting smaller countries in the network periphery to the global market. This evolution of the structure of the global food and agricultural trade network has been shaped by comparative advantage – a country's ability to produce a food at a relatively lower opportunity cost than its trading partner. This comparative advantage depends on the country's natural resource endowments and technological advancements, its geographical location and its trade policies.[8]

For a country, being part of the global food and agricultural trade network ensures the stability of food supply at times of domestic shocks that result in production shortfalls. However, the expansion of the trade network and increased connectivity have led to concerns about the transmission of adverse effects on domestic markets from shocks originating beyond a country's borders. Specific characteristics of the trade network are associated with a shock's propagation dynamics but also with the vulnerability of countries to sudden shocks originating either in their own or their trade partners' markets. For example, for a country, higher connectivity in the global trade network suggests the existence of alternative trade partners, increasing the system's resilience to localized disruptions (for example, see Box 1.4). At the same time, higher connectivity can facilitate the rapid diffusion of shocks across the network.[9,10]

The exact pathways and transmission channels differ depending on the size, nature and location of the shock.[c,11,12] In the short term, shocks may affect countries in three distinct ways, with trade connectivity playing a crucial role in either mitigating or amplifying impacts on food security: (1) a country is affected directly by the production shortfall; (2) a trade partner of the country is affected; and (3) several direct or indirect trade partners of the country are affected.

Domestic production shortfall

When a country experiences a shock and faces a sudden domestic production shortfall, food availability declines and prices rise. Poorer households are unable to afford adequate quantities of food, leading to adverse food security outcomes. Increasing imports enables the country to effectively mitigate impacts on food security. In these situations, countries linked to the global market through a relatively large number of established trade relationships are better positioned to increase their imports to rapidly compensate for the domestic food shortages and to dampen food price increases. For countries that are less well-connected, a shock implies higher risks. A production shortfall cannot be easily compensated for by imports, as developing new trade relationships requires significant and long-term investments to address a complex set of transport, border, information, infrastructure, policy- and risk-related costs.[13]

Cascading effects from a production shock in an exporting country

When a trade partner is hit by a shock, its production and exports decline with the importing country experiencing lower imports, declining food availability and higher prices, negatively affecting food security. If the import-dependent country relies on only a few trade partners, with one of them being affected by a shock, sourcing the missing imports from alternative trade partners can be challenging. However, if the country imports significant volumes from multiple partners and one partner is hit by a shock, increasing imports from the other partners is easier, promoting food availability, stabilizing prices and minimizing impacts on domestic food security. Together with connectivity, the structure of the trade network determines the overall food security effects.

If the exporting country that suffers a shock is a major player in the global market, many importing countries can be affected, including countries that could be trade hubs – transshipment points importing from and exporting food to many other countries. These trade hubs can also experience reduced trade volumes and increasing prices (see Box 2.1). Thus, depending on network structure, the original shock can also trigger cascading effects that can be difficult to predict.

Systemic shock: multiple shocks affecting many locations

A distinct case arises when multiple shocks hit many locations simultaneously. In such a systemic shock, food production declines or collapses across all affected countries. When these countries are also well-connected in the global trade network, the resulting disruption extends beyond their borders, quickly spreading to many

c Trade networks and increased connectivity can also physically transmit and spread certain types of shocks, including contaminants, diseases and invasive species. For example, it has been shown that certain network characteristics correlate with records of large food poisoning outbreaks and that the dispersion of invasive non-native species is strongly determined by global trade networks. This line of research lends support to the important role of transport network monitoring for risk assessment and risk management, including the implementation of preventive biosecurity measures.

BOX 2.1 THE EVOLUTION OF CONNECTIVITY, TRADE HUBS AND RESILIENCE

Trade connectivity evolves in parallel with economic development. Fueled by economic growth, demand and dietary patterns change, leading to more trade as countries develop more import links to source more and a larger variety of foods. Research indicates that once a developing country has established import links with approximately fifty trade partners, it also starts exporting goods to both new and already established trade partners. This transforms the developing country's trade, converting import links to mutual trade links.[49]

Driven by the expansion of the global trade network, increased connectivity and the evolution of global value chains, trade hubs became more important. By facilitating trade between many origins and destinations, these hubs play a central role in the global trade network. It is estimated that around 80 percent of global trade in all goods is shipped indirectly, passing through major hubs.[50] For example, around 70 percent of all imports of the United States of America are imported via an intermediate country.[51]

Trade hubs, acting as brokers and leveraging economies of scale in transportation, facilitate trade and reduce trade costs.[52] They are especially important for smaller countries that cannot easily maintain many trade links.[53] In a region, trade hubs collect supply from smaller countries, shipping it in bulk to other countries or regions in the world. They also pool supply from different parts of the world, distributing it to smaller countries in their region, thus connecting them to the global trade network. Trading hubs emerge because of their geographic position in the network, hosting important ports and featuring high trade openness. As intermediaries, they contribute to price discovery and affect price transmission, attracting significant investment.[54,55,56]

Their centrality in the global trade network makes hubs important for resilience. A study suggests that food deficit countries tend to trade with hubs to benefit from the stability and reliability they offer.[57] By sourcing and agglomerating food supplies from different regions, trade hubs play a buffering role in the global market. However, if affected by a major shock, a hub can also spread vulnerability.[58] Understanding the role of hubs in promoting resilience in the food and agricultural trade network will require more research.

The Kingdom of the Netherlands and South Africa are important trade hubs in food and agriculture. The ports of Rotterdam and Amsterdam make the Kingdom of the Netherlands the third largest exporter and fourth largest importer of food and agricultural products, including grains.[59] With 192 trade links in 2023, the Kingdom of the Netherlands connects almost all countries in the world. In sub-Saharan Africa, South Africa has emerged as a major trade hub, linking many other African countries to the global market.[60] In 2023, South Africa was the best-connected country in Africa, linking more than 180 countries in the world with each other.

trade partners (see Figure 1.2 on the 2007–2008 global food price crisis). While some countries would have to reduce their exports, others would increase their imports, giving rise to a perfect storm in the global market resulting in significant world price spikes and potentially disastrous effects on food security.

Commodity-specific trade networks: wheat, maize and rice

Wheat, maize and rice account for a large share of global food and agricultural trade and are of particular importance for food security, contributing significantly to diets, particularly among poorer population groups.[14] Globally, cereals and cereal preparations accounted for 14.4 percent of the total export value of all food and agricultural products in 2022–2024.[d] Although, on average, wheat, maize, rice and their products contribute around 40 percent of globally available calories, this share increases to 45 percent for net food-importing developing countries. Box 2.2 provides an overview of consumption patterns of these cereals around the world.

Highlighting the significance of cereals in both diets and trade, Figure 2.2 provides an overview of countries' dependency on cereal imports. Countries located in Northern Africa, Western »

d Food and agricultural products encompass all crops and livestock products and their preparations. Fish and aquatic products are not included.

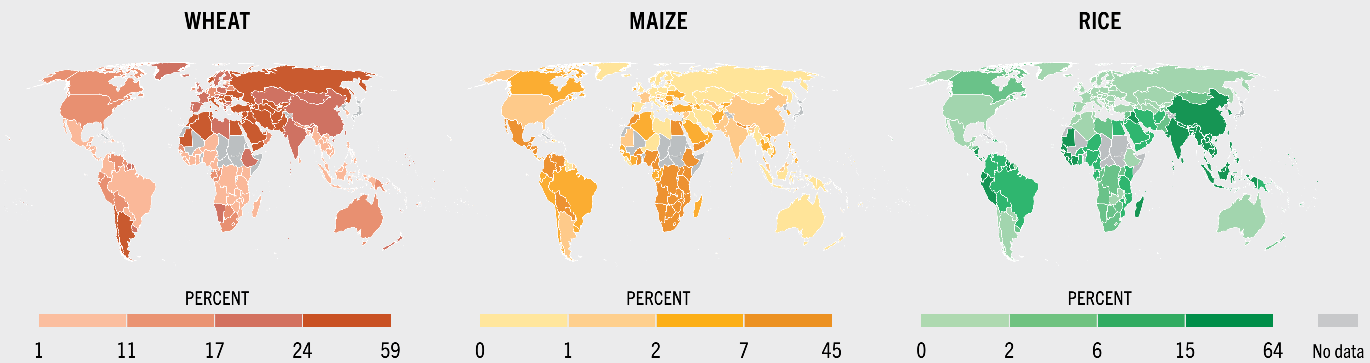
BOX 2.2 WHEAT, MAIZE AND RICE: IMPORTANCE FOR FOOD SECURITY

Wheat, maize and rice play a major role in ensuring food security. Globally, wheat and wheat products contribute around 18 percent of the calories supplied as food, with another 17 percent contributed by rice and rice products. Maize and its products make up around 5 percent of the globally available calories for human consumption.

Staple food consumption preferences are shaped by production patterns and cultural influences and tend to follow regional patterns (see the Figure). Wheat dominates diets in Northern Africa, Western Asia and in more temperate zones in Europe and countries such as Argentina, Australia, Chile and New Zealand. Maize and rice are predominantly grown in warmer countries. Rice dominates Asian diets, plays an important role in South America and is an increasingly important staple in Africa. Maize is preferred across sub-Saharan Africa, Central America and South America. Staple foods, including cereals, tend to be relatively cheaper than other food categories and play an even more important role in food security in lower-income countries and for poor population groups.[61]

In addition to their importance as staple foods, wheat and maize are also used as animal feed, for biofuel and bioenergy, and in manufacturing. It is estimated that 65 percent of all wheat and 11 percent of maize is used for food. About 51 percent of the global maize production is used for feed, 17 percent is used for the production of biofuels and 21 percent is destined for other uses. About 75 percent of global rice production is consumed as food.[62]

FIGURE SHARE OF CALORIES CONTRIBUTED BY WHEAT, MAIZE, RICE AND THEIR PRODUCTS TO TOTALLY AVAILABLE CALORIES, WORLD, 2023

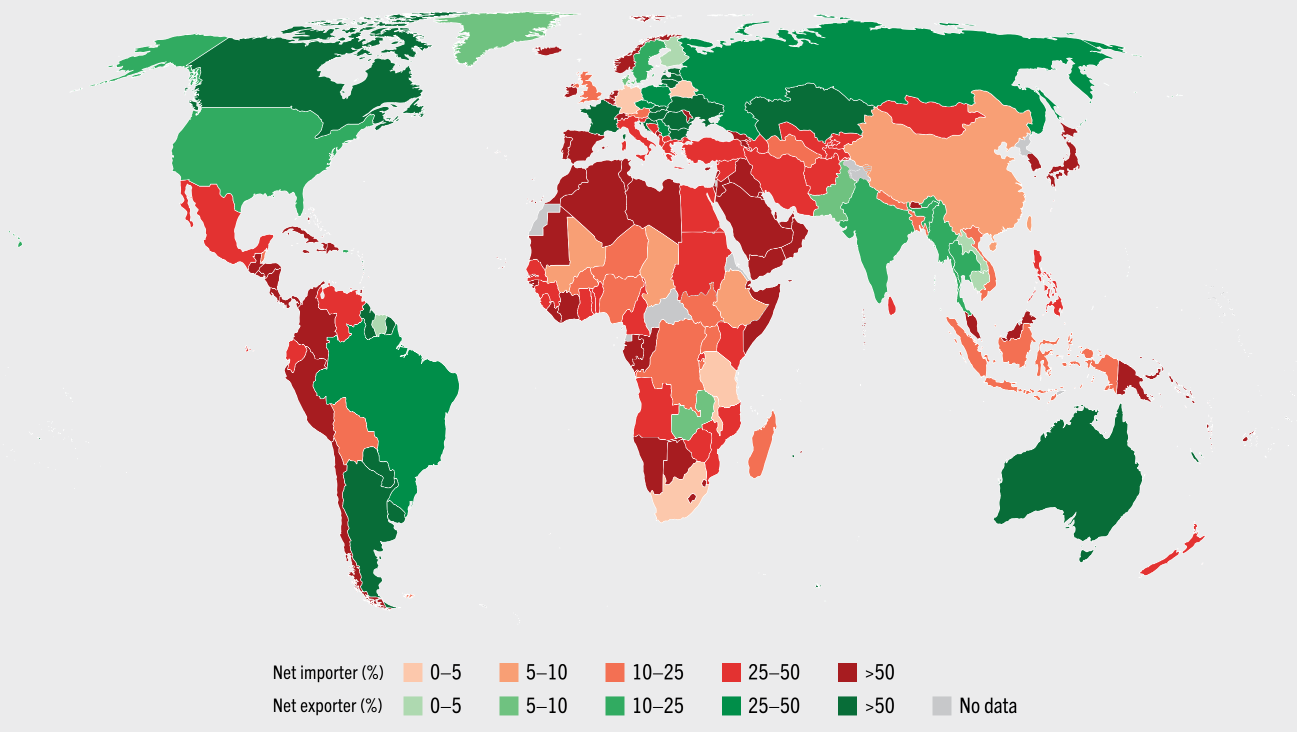


Refer to the disclaimer on the copyright page for the names and boundaries used in these maps. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

NOTES: The maps indicate consumption patterns. Darker shades imply a higher share of the cereal in total calorie availability in the country.

SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Food balances. [Accessed on 20 January 2026]. https://www.fao.org/faostat/en/#data/FBS. Licence: CC-BY-4.0.

FIGURE 2.2 CEREAL IMPORT DEPENDENCY, WORLD, 2022



Refer to the disclaimer on the copyright page for the names and boundaries used in this map. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

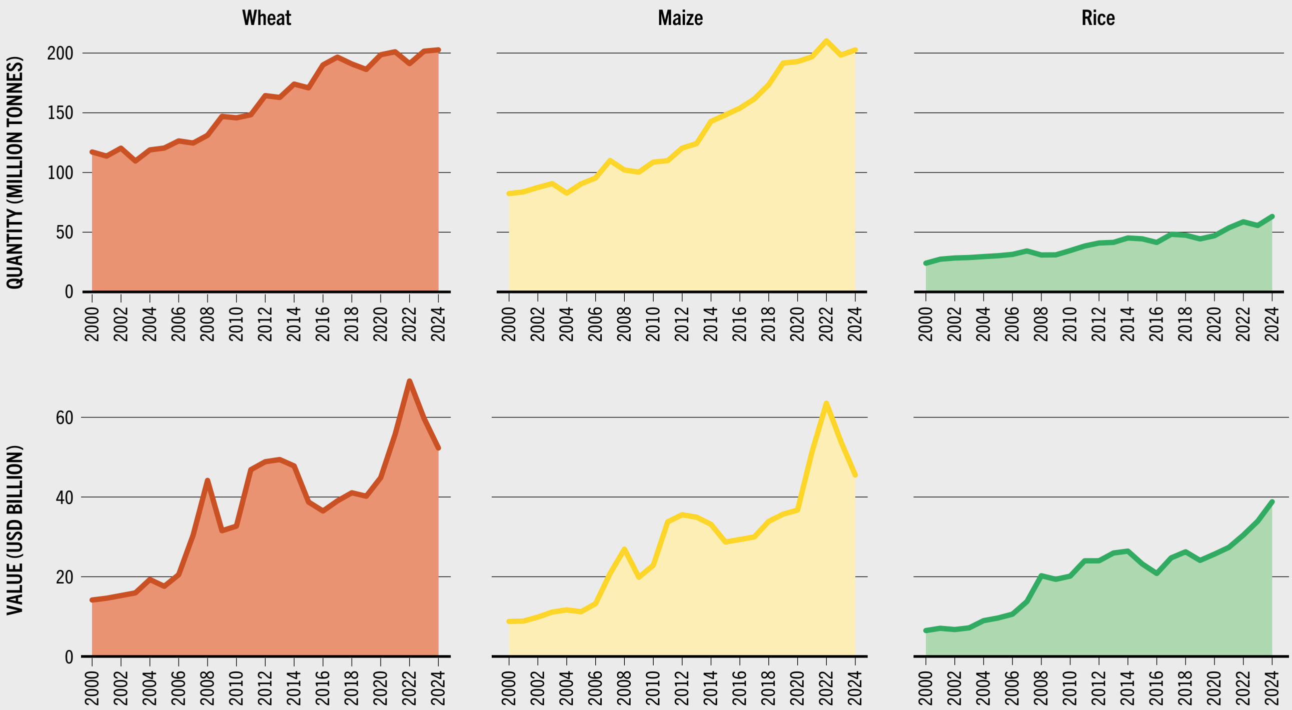
NOTES: Green denotes net exporters and red net importers of cereals. The darker the green (red), the higher the share of net exports (imports) in total cereal availability. Data reflect three-year-averages.

SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Suite of Food Security Indicators. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/FS. Licence: CC-BY-4.0.

» Asia and Central America depend heavily on cereal imports, with more than half of their total cereal availability sourced through trade. Countries with climatic conditions and land endowments favouring cereal production tend to be cereal net exporters, producing quantities well above domestic consumption. For example, the net cereal exports of Argentina, Australia, Canada and Ukraine exceeded domestic needs by more than 100 percent in 2021–2023. Some Southern Asian countries, namely India, Pakistan and countries in South-eastern Asia, are significant rice exporters.

Trade in wheat, maize and rice evolved dynamically, reflecting trends observed in aggregate food and agricultural trade. Between 2000 and 2024, wheat trade increased by 70 percent, reaching 202.7 million tonnes in 2024 (see Figure 2.3). Global maize trade increased even faster, reaching parity with wheat at 202.7 million tonnes in 2024, marking a 150 percent increase compared to 2000. Global rice trade is lower overall. In 2024, it amounted to around 60 million tonnes (in milled rice equivalent), exhibiting a 160 percent increase since 2000. In terms of value, trade in wheat, maize and rice increased significantly between 2000 and 2024, reflecting overall inflation and commodity-specific price fluctuations (Figure 2.3, see **Part 4**).

FIGURE 2.3 **EVOLUTION OF GLOBAL EXPORTS OF WHEAT, MAIZE AND RICE: QUANTITY AND VALUE, 2000–2024**

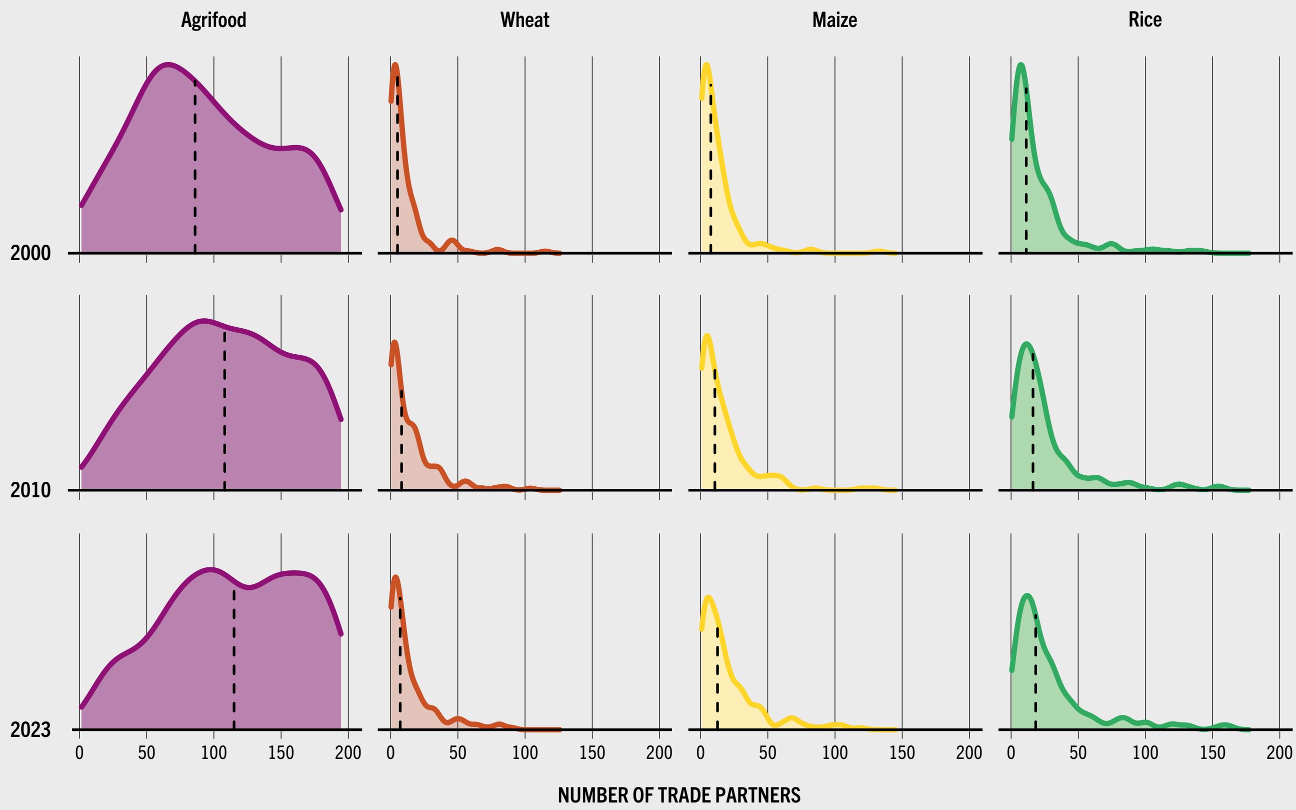


SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Crops and livestock products. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TCL. Licence: CC-BY-4.0.

Despite their importance for food security, global cereal trade networks are significantly more concentrated than for aggregate food and agricultural products (Figure 2.4). Trade connectivity for aggregate food and agricultural products is relatively symmetrically distributed across countries. On average, countries traded with approximately 90 trade partners in 2000, which, as the network became denser, increased to around 115 partners in 2023. Only a few countries have very low or very high connectivity, pointing to a global food and agricultural trade network that is relatively resilient to localized shocks, as for most countries, increased connectivity can significantly reduce their vulnerability.

The wheat, maize and rice trade networks have also evolved from a few major players that dominated trade in the 1990s, to multipolar webs with more major players and relatively reduced individual dominance. New central participants include efficient producers in South America and countries that have gained importance in the global market after the dissolution of the Soviet Union, such as Ukraine and the Russian Federation, and, on the demand side, emerging economies, such as Egypt and Thailand, that are characterized by strong demand driven by population and economic growth. Some countries are trade hubs, pooling imports from different regions in the world and channelling them to smaller countries in the region (see Box 2.1). Despite their evolution,

FIGURE 2.4 GLOBAL TRADE NETWORKS FOR AGGREGATE FOOD AND AGRICULTURE, WHEAT, MAIZE AND RICE: DISTRIBUTION OF TRADE CONNECTIVITY ACROSS COUNTRIES



NOTES: Countries with low connectivity are located on the left tail, those with high connectivity on the right tail of the curves. Symmetric distributions are bell-shaped and have few countries with high and low connectivity. Right-skewed distributions have many countries with low connectivity and reflect concentration. Between 2000 and 2023, connectivity increased in all trade networks. Connectivity in the aggregate food and agricultural trade network is relatively symmetrically distributed, pointing to resilience. Connectivity in the trade networks of wheat, maize and rice is highly concentrated, suggesting efficient systems but also significant dependency. For each distribution, dashed lines depict the median country.

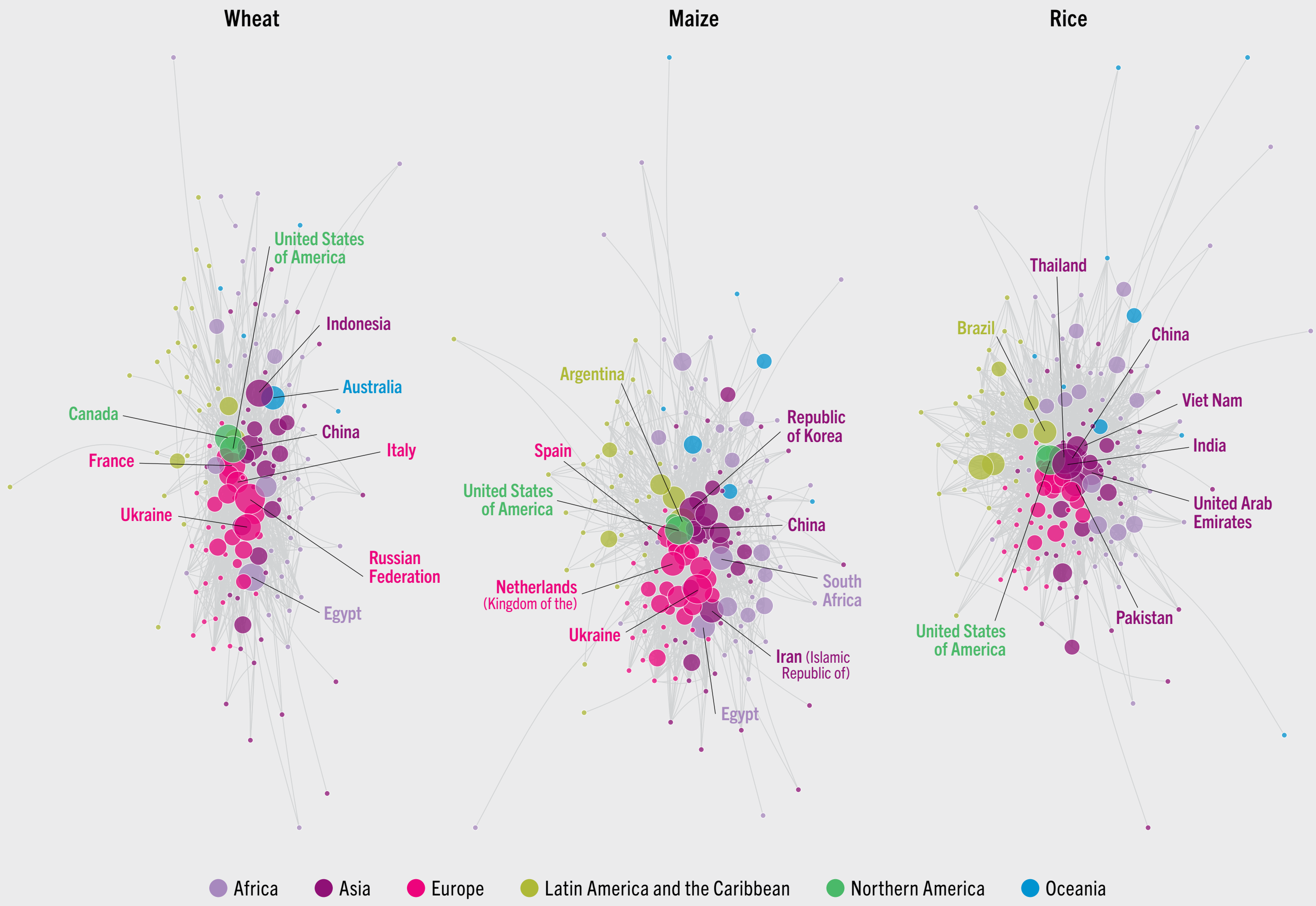
SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Detailed trade matrix. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TM. Licence: CC-BY-4.0.

cereal trade networks remain concentrated with unevenly distributed connectivity, with factors such as geography, natural resources, policies and technology determining the allocation of production and trade patterns across the globe (Figure 2.4).

Although trade intensity in the global **wheat** market is high with approximately one quarter of global wheat production being traded, in 2020, only 9 percent of all potential trade links were used to trade wheat.[e] Nevertheless, the network has become denser over time, with the median country trading wheat with five partners in 2000 and with eight partners in 2023 (Figure 2.4). Central

e Potential trade links are the theoretically possible bilateral trade links considering all countries in the world.

FIGURE 2.5 OVERVIEW OF GLOBAL CEREAL TRADE NETWORKS, 2020



NOTE: The circles denote countries. Large circles are countries with high connectivity and high trade intensity, that is major exporters, importers or trade hubs. When these countries are located in (outside) the core of the network, the network is more centralized (decentralized).

SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Detailed trade matrix. [Accessed on 30 January 2026]. https://www.fao.org/faostat/en/#data/TM. Licence: CC-BY-4.0.

to the network are the top five wheat exporters – Australia, Canada, the Russian Federation, Ukraine and the United States of America – that together account for more than 60 percent of total export value (Figure 2.5). China, Egypt, Indonesia, Italy and the Philippines, making up for 28 percent of total import value, are also central, with most other countries located in the periphery of the network. Major trade hubs in the wheat trade network are mostly European countries, including France, Germany, the Kingdom of the Netherlands, Poland, South Africa, Spain, and the United Kingdom of Great Britain and Northern Ireland.

Trade in **maize** is also concentrated among a few major players (Figure 2.4). With 16 percent of global maize production being traded, in 2020, only 11 percent of all potential trade links were used to trade maize. The median country increased its trade partners from eight in 2000 to thirteen in 2023. Figure 2.5 illustrates the structure of the maize trade network. In the network's core, the main exporters – Argentina, Brazil, France, Ukraine and the United States of America – accounted for nearly 80 percent of global maize exports, with the United States of America contributing more than 31 percent by itself. Top importers, such as China, Japan, Mexico, the Republic of Korea and Viet Nam, accounted for nearly 36 percent of global maize imports.

Rice is also a highly concentrated cereal trade network; however, the global rice market is characterized by low trade intensity. Approximately 10 percent of the global rice production is traded in global markets, while around 16 percent of all potential links are used to trade rice. Connectivity increased with the median country trading with 12 partners in 2000 and 19 in 2023 (Figure 2.4). India, Pakistan, Thailand, the United States of America and Viet Nam are the top five rice exporters, accounting for around 75 percent of all rice exports globally (Figure 2.5). On the import side, the top five importers combined accounted for around 25 percent of global imports.

While cereal trade networks became less centralized and connectivity improved, they remain highly concentrated, which can make them susceptible to shocks. Among food trade networks, cereals have distinctive core–periphery patterns, reflecting an efficient allocation of global production across countries and ensuing trade routes.[15] These patterns have been shaped by comparative advantages in the production of wheat, maize and rice, driven by climate, land endowments and technology, in combination with the high tradability of cereals. In contrast, fruits and vegetables, whose production requires specific soils and climatic conditions and whose perishability limits trade, form more decentralized structures with less dominant players.[16] ■

ASSESSING RESILIENCE AND IDENTIFYING VULNERABLE COUNTRIES

The structure of global trade networks can determine how shocks propagate. Symmetric networks, such as that of the global food and agricultural trade, tend to be resilient and can buffer shocks that affect a single country or even a few countries, with impacts dissipating quickly, being absorbed by many participants. In contrast, concentrated trade networks that are dominated by a few major players, such as the global networks of wheat, maize and rice, are more susceptible to cascading effects. In such structures, a shock affecting a single major player can propagate through the entire network, reducing trade, raising prices and amplifying their adverse effects on food security.[17,18,19]

Regional structures within the global trade network can also determine shock propagation. Countries tend to trade more within their regions than across, with trade relationships being shaped by geographical proximity and trade agreements. With limited connectivity across regions, shocks are more likely to propagate within the affected region.[20] Thus, for a country, a combination of import dependency, connectivity and position in the trade network can determine its vulnerability to shocks originating within or beyond its borders.[21]

Simulation models can help better understand how shocks can propagate in the trade network and how they affect countries. In this line of research, analysts build models resembling the trade network and apply various shock scenarios to assess immediate impacts on trade and to identify vulnerable countries before further adjustments take place. Most simulation studies focus on local shocks, where one or a few of the major players are affected, or systemic shocks with many countries being hit by the shock.

A simulation study conducted for this report focuses on how shocks propagate across the global trade networks of wheat, maize and rice in line with two main hypothetical scenarios and additional scenario variations.[22] One scenario considers extreme weather events affecting a single, critical exporter and ensuing effects on other countries. The other scenario considers multiple, simultaneous extreme weather events affecting crop production around the world. While weather events are chosen for illustrative purposes, similar effects could evolve from other shocks affecting production, such as conflicts, plant diseases, agronomic or economic failures. Box 2.3 provides details on the model and the scenario assumptions used for the simulation.

Scenario I: Simulating a dust bowl shock

The analysis of the dust bowl shock scenario illustrates how a severe shock on a single important producer can propagate globally, with significant effects on food security far beyond the affected country. The United States of America is a major exporter of wheat, maize and rice and is a central player in the trade networks of all three staples.

BOX 2.3 SIMULATION MODEL AND SCENARIOS

SIMULATING THE PROPAGATION OF SHOCKS THROUGH THE CEREAL TRADE NETWORKS

The trade network model used in this report is designed to portray the cascading effects of shocks on the production of wheat, maize and rice as they propagate through their respective trade networks. The simulations quantify production shortfalls, impacts on exports and imports as well as impacts on food availability, world prices and food security. The results obtained are then compared to a no-shock benchmark, a common approach in academic literature.[63,64]

Simulations are conducted through a sequence of steps capturing the potential paths of shocks and countries' responses within the trade networks of these cereals. The exercise assumes a reduction in global production that triggers an increase in world prices. As a result, imports decline, while countries that are directly affected by the shock may reduce their exports. Countries can use up to 50 percent of their cereal stocks to compensate for the decline in imports and exports.* If this is not sufficient, countries reduce their exports to promote domestic food availability. This creates a sequential effect as the shock is propagated across the global trade network. Income plays an important role in the model simulation, as richer countries can afford higher prices, mitigating their vulnerability.

While simulation models create a representation of real-world trade networks to test "what if" scenarios, they are not meant to forecast future outcomes. Instead, they provide a framework for risk assessment by assessing immediate effects of shocks and identifying countries that could be vulnerable, based on their connectivity and position in the global trade network. Other studies have simulated the formation of trade networks. A simulation study of the global wheat network, for example, has shown how the network itself may adjust in response to the severity, frequency and duration of different types of shocks, thus improving its resilience.[65]

Scenario I: The dust bowl shock

The dust bowl crisis spanned the years from 1930 to 1936 with three of the six driest and hottest growing seasons in the United States of America since the beginning of the twentieth century (see also Box 2.4).[66] It is estimated that, despite all advancements in farming practices and technology, a similar drought would still result in production losses of about 40 percent for maize, 30 percent for wheat and 20 percent for rice in the United States of America. This scenario mimics the dust bowl crisis, assuming production losses in the United States of America accordingly, and simulating the propagation of these shocks around the world. The probability of such an event is estimated to be around 1 in 100 years.[67]

Scenario II: The global food system shock

This scenario explores a systemic, multicountry shock to food production, inspired by a 2015 Lloyd's report that involves assumptions for a plausible confluence of catastrophic weather events linked to a strong warm-phase of the El Niño Southern Oscillation in the central equatorial Pacific Ocean.[68] This leads to severe flooding in agricultural production areas of the United States of America, and a combination of major droughts and torrential rainfall, flooding and landslides across Asia. Severe drought affects eastern and south-eastern Australia. In addition, the Ug99 wheat stem rust pathogen is assumed to be windblown throughout the Caucasus and further north, affecting wheat production in India, Kazakhstan, Pakistan, the Russian Federation, Türkiye and Ukraine. The scenario stipulates a complex crisis with simultaneous production failures in key agricultural areas around the world. The combined effect implies an aggregate decline in global production of 10 percent for maize and 7 percent for each of rice and wheat. The probability of such an event is estimated to be higher than 1 in 200 years.

NOTE: * No distinction is made on whether stocks are private or public.
SOURCE: Adapted from Schiavo, S. & Mangioni, G. (forthcoming). *Global food trade network: Assessing vulnerability to shocks – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO.

A dust bowl shock in the United States of America would lead to a 40 percent reduction in maize, while wheat and rice production would drop 30 and 20 percent, respectively. As a result, and according to the model's assumptions, exports of maize and rice from the United States of America cease, while wheat exports decline significantly, sending shockwaves throughout the global trade networks of these cereals. The simulation suggests that many countries reduce their imports and exports substantially, while a few countries are no longer able to import at all. An estimated 32 percent of the bilateral

BOX 2.4 DUST BOWL: FROM SHOCKS TO RECOVERY

The Dust Bowl was a major crisis that reshaped the landscapes and agricultural policy of the United States of America. Beginning with severe drought in the Great Plains in 1930, dust storms started in 1931 and worsened between 1934 and 1936 leading to widespread soil erosion, crop losses and large-scale migration.[69,70] Millions of tonnes of topsoil were displaced during the 1930s, stripping fields of nutrients and organic matter essential for plant growth.[71] Agricultural production fell sharply and repeated dust storms destroyed standing crops, air quality deteriorated and ecological balances across the region were disrupted.[72,73] Widespread farm abandonment and rural outmigration followed as falling output deepened existing financial pressures.[74]

These environmental shocks unfolded amid the broader economic crisis of the Great Depression. Agricultural prices had already been declining due to overproduction, falling global demand and deflation. With mass unemployment reducing consumer purchasing power and banks restricting credit, many farmers sold crops below production costs to service debts and taxes. The result was deep rural poverty, widespread foreclosures and accelerated migration.[75]

The crisis revealed the need for change; recovery efforts introduced soil conservation practices and reflected a shift from maximizing short-term yields toward managing ecological limits and long-term soil health.[76] Ultimately, the Dust Bowl marked a turning point in ecological, economic and institutional resilience, emphasizing the interconnectedness of agriculture, environment and governance.[77]

trade links for maize and rice are severed and 15 percent of the bilateral trade links for wheat are lost. Globally, reductions in food availability result in a substantial 57.6 percent increase in cereal prices.

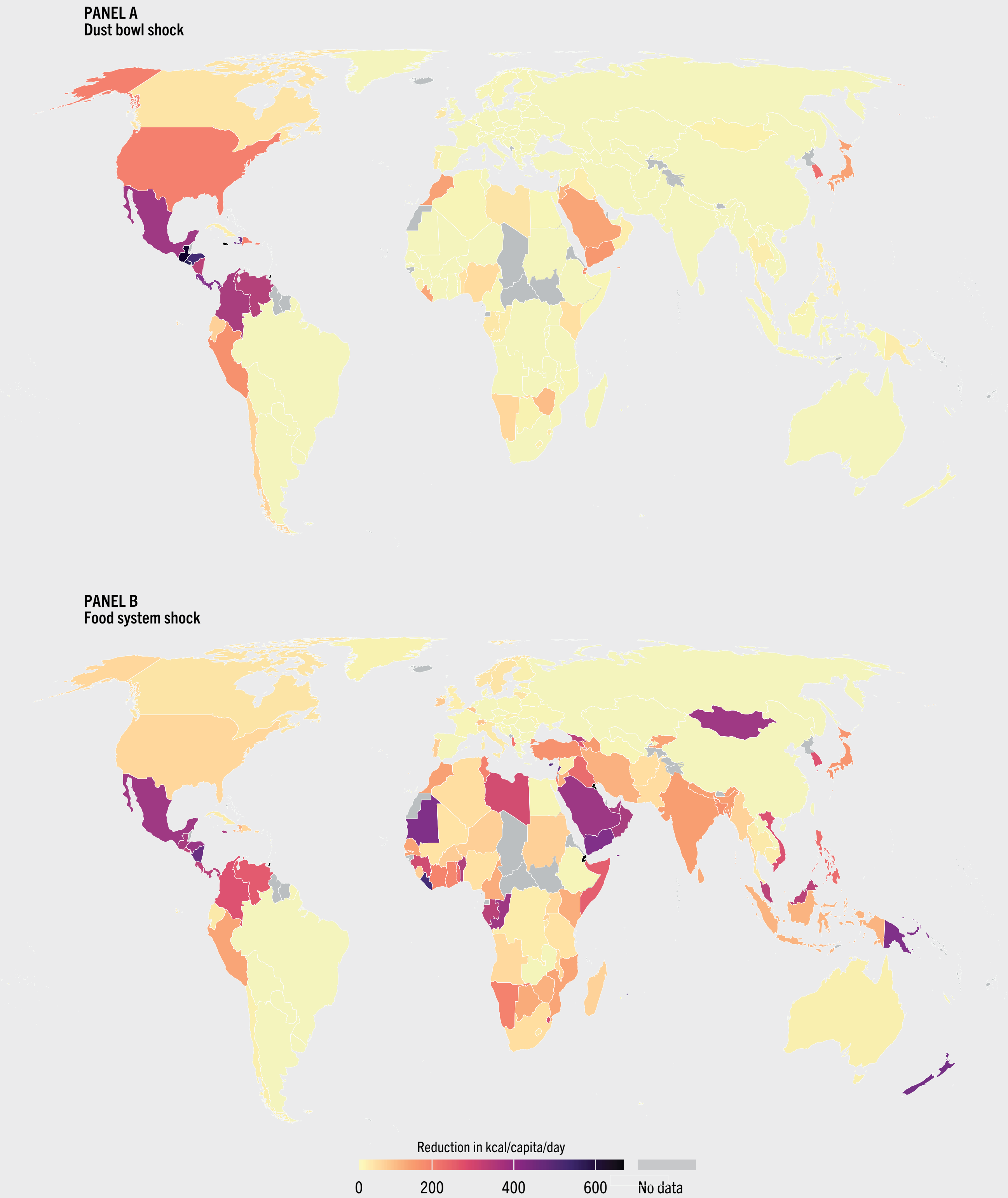
In terms of food security, the shock leads to a reduction of 180 kcal per capita per day from wheat, maize and rice in the United States of America. Countries in Central America and the Caribbean that are heavily dependent on exports from the United States of America are most affected (Figure 2.6, **Panel A**).
El Salvador, Guatemala, Honduras, Jamaica, and Trinidad and Tobago face caloric reductions exceeding 500 kcal per capita per day. Except for Guatemala, these nations are all net food-importing developing countries. For example, Honduras, a lower-middle-income country, sources all its wheat and over 90 percent of its maize and rice imports from the United States of America. Small Island Developing States, such as Jamaica and Trinidad and Tobago, are subject to higher trade costs and lower connectivity because of their geography. High-income countries located far away from the origin of the shock are also affected. Japan and Saudi Arabia both experience a decrease of more than 100 kcal per capita per day in maize imports from the United States of America, most of which is destined for feed. Overall, energy availability declines by more than 250 kcal per capita per day in 13 countries, resulting in an additional 40.9 million people falling below the minimum caloric intake that defines hunger.[23]

Scenario II: Simulating a global food system shock

The global food system shock scenario simulates a more complex and compound crisis, involving simultaneous production failures in multiple countries. Severe flooding in the United States of America reduces maize and wheat harvests by 27 percent and 7 percent, respectively. A combination of major droughts and torrential rainfall, flooding and landslides across Asia causes significant production losses of rice and wheat. Australia is assumed to experience a 50 percent decline in wheat production due to severe droughts, and a wheat disease substantially affects production in India, Kazakhstan, Pakistan, the Russian Federation, Türkiye and Ukraine. The shock results in a combined global production shortfall of 10 percent for maize and 7 percent for each of rice and wheat.

Affecting multiple major producers at the same time, the systemic shock rattles connectivity in all trade networks. For rice, 55 percent of bilateral trade links are interrupted, while for wheat 37 percent of the links are severed. Bilateral trade links for maize decline by around 32 percent. Globally, declines in the availability of cereals trigger a 70 percent increase in world cereal prices, affecting diverse countries. Import-dependent countries, irrespective of income levels, and countries in the Global South face the most severe effects on food security (Figure 2.6, **Panel B)**. For instance, Djibouti, Kuwait, Liberia, and Trinidad and Tobago are among the most vulnerable, with »

FIGURE 2.6 IMPACT OF A HYPOTHETICAL DUST BOWL SHOCK AND A HYPOTHETICAL FOOD SYSTEM SHOCK ON FOOD SUPPLY ACROSS COUNTRIES



Refer to the disclaimer on the copyright page for the names and boundaries used in these maps. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties. Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined.

NOTES: Model simulation results for two hypothetical scenarios. The dust bowl shock (**Panel A**) affects cereal production in the United States of America, the food system shock (**Panel B**) affects cereal production in several countries around the world. Darker shades suggest larger per capita losses of calories through direct effects of the shocks or effects transmitted through trade.

SOURCE: Authors' own elaboration based on Schiavo, S. & Mangioni, G. (forthcoming). *Global food trade network: Assessing vulnerability to shocks – Technical note for The State of Agricultural Commodity Markets 2026*. Rome, FAO.

» reductions in calorie availability from wheat, maize and rice of more than 500 kcal per capita per day. Kuwait, which imports 97 percent of its cereals, sees a reduction of over 900 kcal per capita per day from wheat and more than 470 kcal from rice, reflecting its heavy reliance on Australia for wheat and India for rice – both affected by the shock. Liberia, a highly import-dependent low-income country, faces losses of about 375 kcal per capita per day in rice, its main staple, and 125 kcal in wheat, driven by its almost complete dependence on rice imports from India. In total, the simulation suggests that 35 countries can experience reductions of over 250 kcal per capita per day, with the number of undernourished people increasing by more than 160 million.[24] ■

OPENNESS TO TRADE AND INTERNATIONAL COOPERATION

Trade is indispensable for food security, promoting food availability and enriching its diversity, thus enabling healthy diets worldwide.[25] By leveraging countries' comparative advantage, trade boosts economic growth, provides livelihoods for farmers and lowers prices, improving food affordability.[26,27]

Vulnerability and efficiency gains

Trade can buffer the impact of domestic shocks to production, while better trade connectivity can also cushion the impacts of shocks originating beyond a country's borders. However, trade can also become an avenue through which global shocks are transmitted to domestic economies, increasing their vulnerability. Policies governing a country's integration into global markets should carefully balance mitigating vulnerabilities with the pursuit of greater efficiency gains.

The simulation exercise in this report and other studies reveal several key points:

i. Countries directly affected by shocks and their direct trade partners experience greater declines in food availability.[28]
ii. Countries that source most of their imports from a single supplier are more vulnerable to shocks. Having diversified import links helps mitigate the effect of shocks on food security, but this also depends on the volume traded through these links.[29]
iii. The use of food stocks to offset the impact of shocks on production could improve food security.[30]
iv. When local shocks generate cascading effects, such as in the dust bowl shock scenario, trade hubs could help buffer impacts on their partners.[31]
v. Low-income and import-dependent countries are especially vulnerable to global shocks and, often, are unable to use trade to buffer domestic production shocks.[32,33]
vi. Vulnerability to food commodity-specific shocks aligns with regional consumption patterns. Countries in Western Asia tend to be vulnerable to shocks in wheat, while maize shocks increase vulnerability for Central America and rice shocks for Western Africa[34,35,36] The most vulnerable countries tend to be concentrated in a few regions, including Central America, sub-Saharan Africa and South-eastern Asia.[37,38]
vii. Even wealthier import-dependent nations are not immune. Declines in food availability and ensuing price increases can force low-income households to switch to less nutritious food options.[39]

Highly concentrated trade networks may propagate shocks rapidly, exposing countries to vulnerability in the short term. At the same time, in the longer term, no country in the world can sustain food security and enable healthy diets in isolation. Balancing policies for long-term objectives with immediate responses to sudden shocks that affect food security, especially through adjusting a country's orientation towards trade openness, requires careful consideration.

In the long term, openness to trade can foster agricultural growth. By leveraging comparative advantage, countries can enhance productivity,[40,41] facilitate technology and knowledge spillovers,[42] and allocate natural resources more efficiently. These mechanisms can lead to significant gains and contribute to improved food security for all.[43,44,45,46]

Research indicates that the same mechanisms, triggered by trade openness and leveraging comparative advantages, also give rise to specific network structures. Trade network structures with higher and more equally distributed connectivity among countries – such as in the aggregate food and agricultural trade network – are more resilient and help countries minimize their vulnerability to shocks in their domestic markets or impacts spilling over from trade partners (see also **Part 3**, Box 3.3 for examples on how trade can buffer effects of domestic shocks).[47] However, for structures, such as the cereal trade networks – where certain countries are major producers and exporters while others are more peripheral, higher concentration translates into reduced resilience to shocks. In these cases, international cooperation can mitigate the effects on global food security.

The role of international cooperation

Both shock simulations presented above assume the cooperative behaviour of all countries in terms of the mobilization of up to 50 percent of existing domestic cereal stocks to compensate for the reduction in imports and to continue exporting to trade partners. Additional variations in the assumptions of these scenarios illustrate how countries' cooperative (or non-cooperative) behaviour can strengthen (or weaken) the resilience of markets and reduce (amplify) countries' vulnerability (concrete cases of international cooperation are illustrated in Box 3.1 on the COVID-19 pandemic and Box 3.4 on the Black Sea Grain Initiative).[48]

Cooperative behaviour: using food stocks to compensate for imports and to create new trade links for exports

As shocks lead to trade links between countries being severed, strengthening international cooperation by using food stocks to create new trade links mitigates impacts across the trade network. These newly formed trade links dampen negative impacts on food security. In the dust bowl shock scenario, the additional number of people undernourished decreases to 40.1 million – 0.8 million fewer than in the original (baseline) scenario setup (Figure 2.7, **Panel A**). About 34 countries experience improvements in terms of caloric reductions and, importantly, no country fares worse compared to the original setup (Figure 2.7, **Panel B**).

In the food system shock scenario, international cooperation reduces the increase in undernourished people to 162.5 million undernourished people – fewer than in the baseline setup where 163.8 million people were added to the undernourished (Figure 2.7, **Panel C**). New link creation under the food system shock dampens negative food security impacts for 35 countries. Only two countries are left slightly worse off, by approximately 2 kcal per capita per day – than in the baseline setup (Figure 2.7, **Panel D**), making this a negligible effect.

Non-cooperative behaviour: using food stocks only to compensate for imports

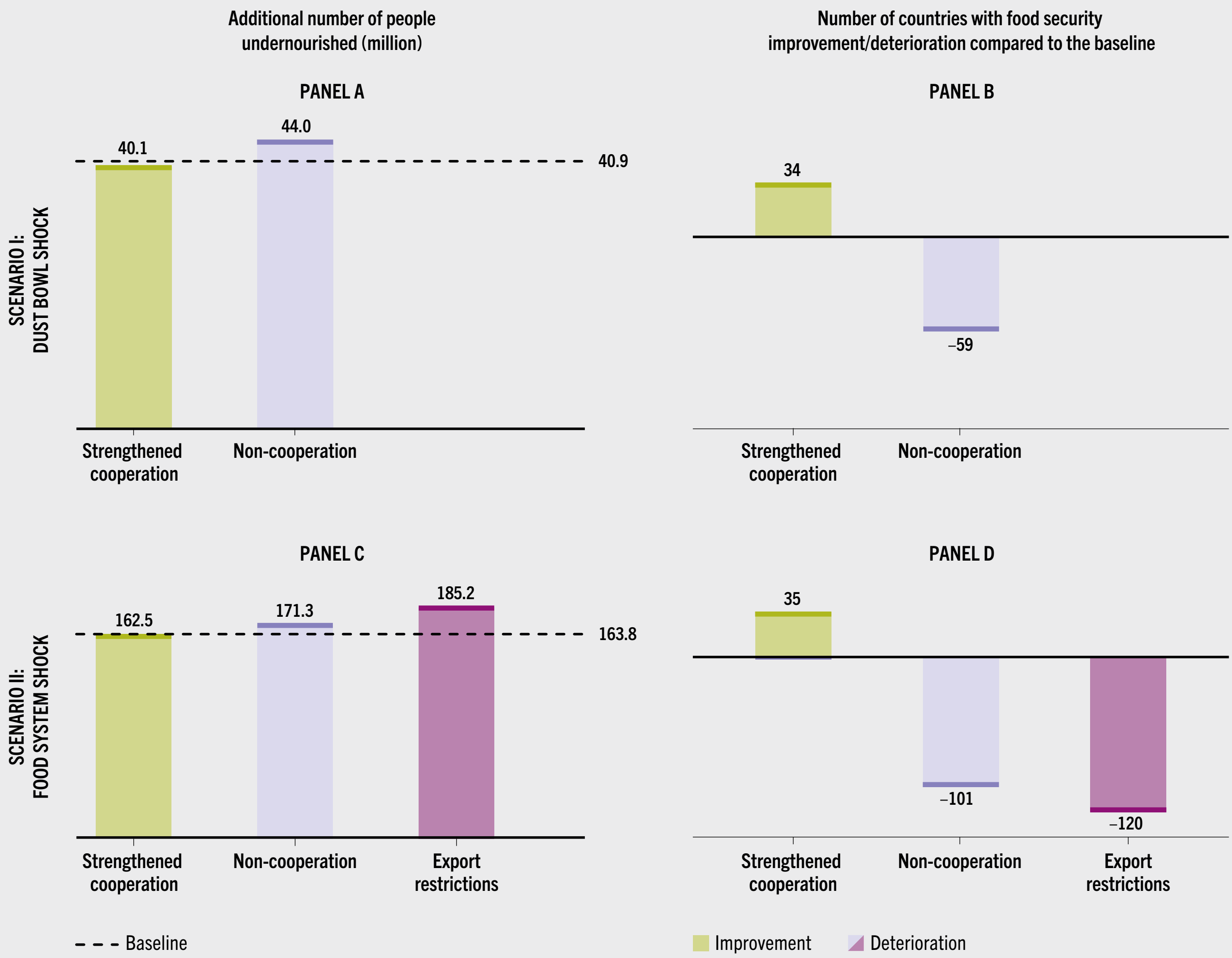
Restricting the use of cereal stocks only to compensate for the decline in imports without maintaining exports, substantially worsens food security outcomes. In the dust bowl shock scenario, this approach results in an additional 44 million people facing undernourishment – an increase from 40.9 million in the baseline setup (Figure 2.7, **Panel A**). Caloric reductions worsen in 59 countries as compared with the baseline, with no country showing improvement (Figure 2.7, **Panel B**).

In the food system shock scenario, the widespread reduction in exports triggers cascades of shortages. The increase in the number of undernourished rises to 171.3 million people, up from 163.8 million in the baseline (Figure 2.7, **Panel C**). About 101 countries experience larger reductions in calorie availability than under the cooperative approach assumed in the baseline, with no country benefitting (Figure 2.7, **Panel D**).

Non-cooperative behaviour: imposing export restrictions

An additional assumption is introduced to the food system shock scenario to simulate short-term panic in response to the shock. In this configuration, not only do countries refrain from cooperation but main exporters – even if not directly affected by the shock – also impose export restrictions, limiting cereal exports to 75 percent of the pre-shock volumes. Under intense pressure from extreme weather events and compounded by policy-induced disturbances, this setup leads to the most adverse food security outcomes among all scenarios. Non-cooperative behaviour with

FIGURE 2.7 COMPARISON OF GLOBAL FOOD SECURITY OUTCOMES FOR DIFFERENT SCENARIOS WITH AND WITHOUT INTERNATIONAL COOPERATION



NOTES: Model simulation results for two hypothetical scenarios. The dust bowl shock (**Panels A** and **B**) affects cereal production in the United States of America, the food system shock (**Panels C** and **D**) affects cereal production in several countries around the world. The bars show direct impacts and impacts transmitted through trade on food security, compared to a baseline scenario. Strengthened international cooperation improves food security, while non-cooperation and export restrictions reduce it.

SOURCE: Authors' own elaboration based on Schiavo, S. & Mangioni, G. (forthcoming). *Global food trade network: Assessing vulnerability to shocks – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO.

export restrictions reduces the volume of cereals in the global market and leads to significant market distortions. As a result, 185.2 million people are added to the undernourished – 21.4 million more than in the baseline (Figure 2.7, **Panel C**). Moreover, 120 countries experience deteriorating food security outcomes than in the baseline setup, with no country, including those that restricted exports, showing improvements (Figure 2.7, **Panel D**). Market insulation through trade restrictions does not entirely shield countries from shocks, but weakening the resilience of global markets increases the vulnerability to such disruptions for all. ■

INDIA
A woman in traditional clothing kneels in an arid field to plant seedlings.
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PART 3
DYNAMIC IMPACTS OF WEATHER SHOCKS ON TRADE – ARE GLOBAL FOOD MARKETS RESILIENT?

SUMMARY

Part 3 explores the resilience of global food and agricultural trade networks to past shocks. It discusses disruptions and the evolution of their effects on food and agricultural trade, focusing on dynamic adjustments and on the role that international cooperation plays in fostering resilience.

KEY MESSAGES

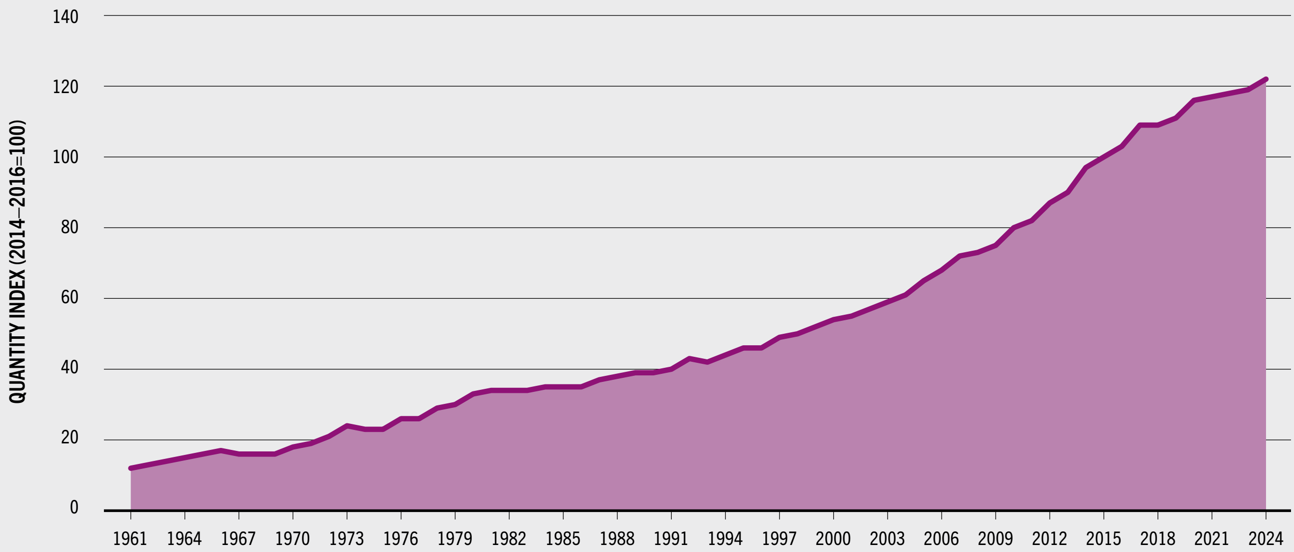
➔ The global food and agricultural trade network has proven resilient in the face of past shocks, enabling the movement of food from surplus to deficit regions. Global markets successfully adjusted to shocks, such as the COVID-19 pandemic or the disruption of exports from major agricultural producers at the beginning of the war in Ukraine.

➔ Shocks can still lead to substantial short-term disruptions of trade flows. So far, these effects have been transitory, pointing to the capacity of the global trade network to absorb, adapt to and recover from shocks. Nevertheless, even short-term trade effects can give rise to significant food security risks, while multiple and recurring shocks arising from different sources, such as weather extremes, conflicts, socioeconomic crises or pandemics, can have compound effects that are more persistent.

➔ On global average across bilateral trade links, export volumes decline significantly due to a shock, with the effects fading within a period of six months. Weather shock effects on trade at the country level can be significant and are often followed by policy interventions, especially in vulnerable import-dependent countries.

➔ Effective integration in the global market and well-diversified trade connectivity can be important long-term strategies to build and strengthen resilience to shocks. International cooperation in maintaining and rebuilding trade flows is fundamental to overcome and recover from shock impacts.

FIGURE 3.1 EVOLUTION OF GLOBAL FOOD AND AGRICULTURAL TRADE VOLUME, 1961–2024



SOURCE: Authors' own elaboration based on FAO. 2026. FAOSTAT: Trade – Trade indices. [Accessed on 3 March 2026]. https://www.fao.org/faostat/en/#data/TI. Licence: CC-BY-4.0.

ARE GLOBAL FOOD MARKETS RESILIENT?

At the global level, aggregate food and agricultural trade has proven resilient to shocks (see **Part 1**). Since 1961, global aggregate food and agricultural trade has grown almost without significant disturbances (Figure 3.1). However, this global aggregate masks fluctuations at the food commodity level (see Figure 2.3). Additionally, analysing annual values can conceal within-the-year movements. For example, while aggregate food and agricultural trade increased during the COVID-19 pandemic in 2020, virus containment measures and trade policy responses still led to significant trade disruptions in the first months of that year (Box 3.1).[1,2]

Monthly trade of cereals can fluctuate significantly, with regular patterns following growing seasons in different regions of the world and irregularities caused by shocks (Figure 3.2). Weather shocks, especially, affect agricultural markets directly and frequently (see **Part 1**).

For most crops, optimal growing conditions are within a narrow climatic range, outside of which, yields decline or even collapse.[3] Interannual weather variations play an important role in determining crop yields. Globally, on average, approximately one-third of yield variability for wheat, maize and rice can be explained by weather fluctuations. In some major production areas, even over 60 percent of yield variability is estimated to be the result of weather impacts.[4]

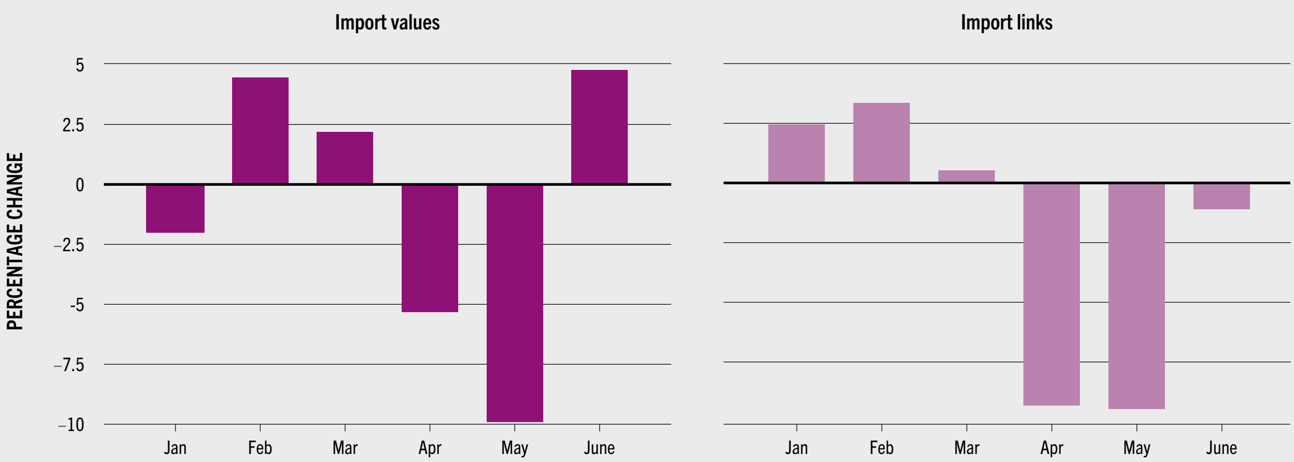
In general, crops tend to be more affected by drought than by excess rainfall. Co-occurring hot and dry events negatively affect wheat, maize and rice yields, while the impacts of cold and wet events tend to be lower and more uncertain.[5] »

BOX 3.1 THE REMARKABLE RESILIENCE OF FOOD AND AGRICULTURAL TRADE DURING THE COVID-19 PANDEMIC

To contain the spread of COVID-19 in 2020, governments around the world adopted measures such as temporary business closures, confinements, curfews, quarantines and travel restrictions within and across borders. Beginning with China on 23 January 2020, most countries in the world had implemented lockdowns by the end of March 2020. Only around mid-May 2020 did governments start easing restrictions, and economic activity, at least partly, resumed.

Lockdowns, border and travel restrictions led to shortages of agricultural labour, hampered supply chains and trade logistics, and affected food demand, immediately impacting global food and agricultural trade in the first half of 2020 (see the first Figure). In April and May 2020, trade disruptions reduced the number of global agricultural and food import links by 9 percent compared to previous years. Import values declined by 5 percent in April, followed by an even greater reduction in May. While basic foods, such as cereals, fruits and vegetables were hardly affected, trade of non-food commodities including cotton, live plants and cut flowers declined significantly during the first months of the COVID-19 outbreak (see the second Figure). However, with easing virus containment measures, in most cases, trade recovered to nearly pre-pandemic levels already in June.

FIGURE DYNAMICS OF GLOBAL FOOD AND AGRICULTURAL TRADE DURING THE COVID-19 PANDEMIC, JANUARY TO JUNE 2020



NOTE: Percentage change in 2020 compared to the same month average in 2018 and 2019.

SOURCE: Authors' own elaboration based on FAO. 2021. *Agricultural trade & policy responses during the first wave of the COVID-19 pandemic in 2020*. Rome. https://doi.org/10.4060/cb4553en

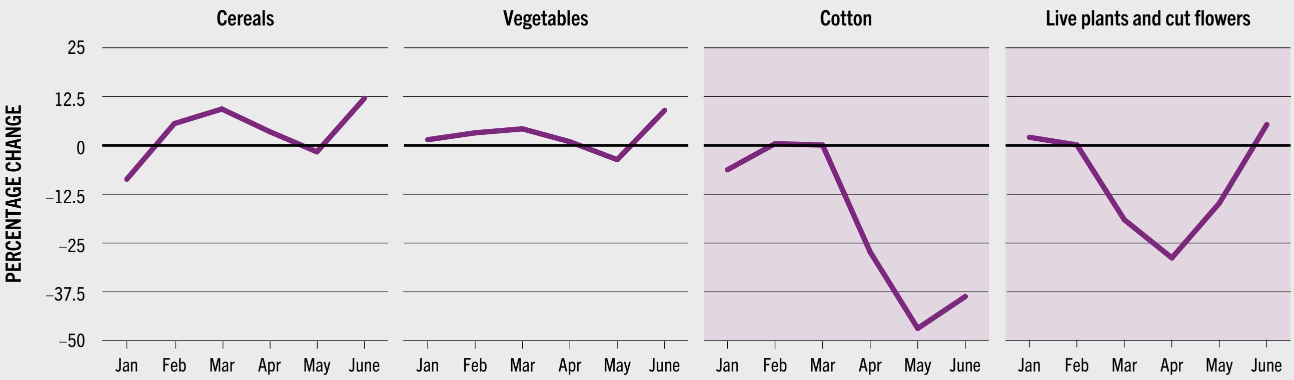
BOX 3.1 (Continued)

Concerns over food security and food safety at the beginning of the pandemic induced policy responses to address potentially adverse impacts on domestic markets. Some major exporting countries imposed export bans or quotas on specific food commodities, a few countries restricted imports or introduced additional shipment requirements. However, most of these trade measures were short-lived and their impact was limited. At the same time, to ensure the availability of critical food items and contain potential food price increases, many countries lowered existing import tariffs. Some countries temporarily relaxed technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures or implemented trade-facilitating measures, including electronic phytosanitary and veterinary certificates and simplified import-licensing procedures.

Overall, effects on global trade in food and agriculture remained limited to short-term disruptions at the very beginning of the pandemic. This remarkable resilience, underlining the critical importance of trade for food security, was supported by governments and supply chain actors worldwide. The international community played an important role in limiting the use of trade restricting measures during the pandemic. Through several joint ministerial declarations and statements, many countries made non-binding commitments to refrain from using trade restrictions. Such international political commitments were pivotal in the coordination of a global response to the pandemic and in avoiding unilateral measures that could have further harmed food security globally.

SOURCE: Adapted from FAO. 2021. *Agricultural trade & policy responses during the first wave of the COVID-19 pandemic in 2020.* Rome. https://doi.org/10.4060/cb4553en

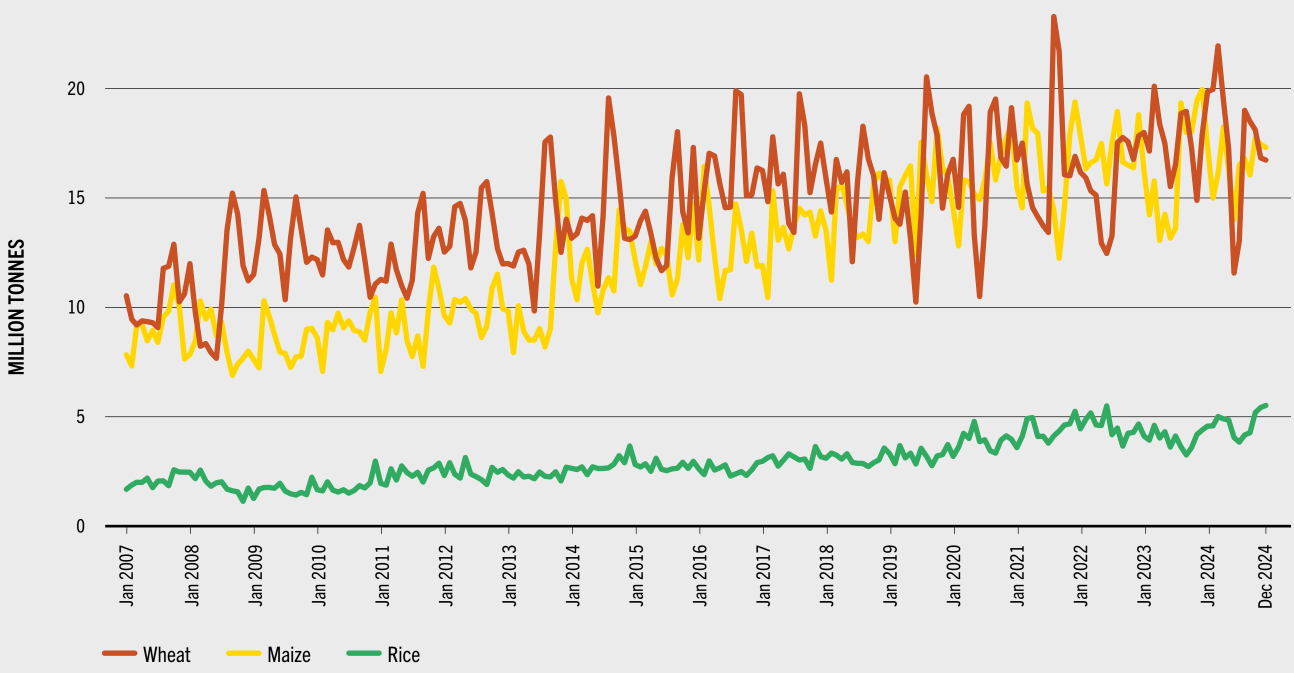
FIGURE GLOBAL TRADE DYNAMICS OF SPECIFIC FOOD AND NON-FOOD PRODUCTS, JANUARY TO JUNE 2020



NOTES: Percentage change in global import values in 2020 compared to the same month average in 2018 and 2019. Shaded panels are non-food products.

SOURCE: Authors' own elaboration based on FAO. 2021. *Agricultural trade & policy responses during the first wave of the COVID-19 pandemic in 2020.* Rome. https://doi.org/10.4060/cb4553en

FIGURE 3.2 MONTHLY TRADE OF WHEAT, MAIZE AND RICE AT GLOBAL LEVEL, JANUARY 2007–DECEMBER 2024



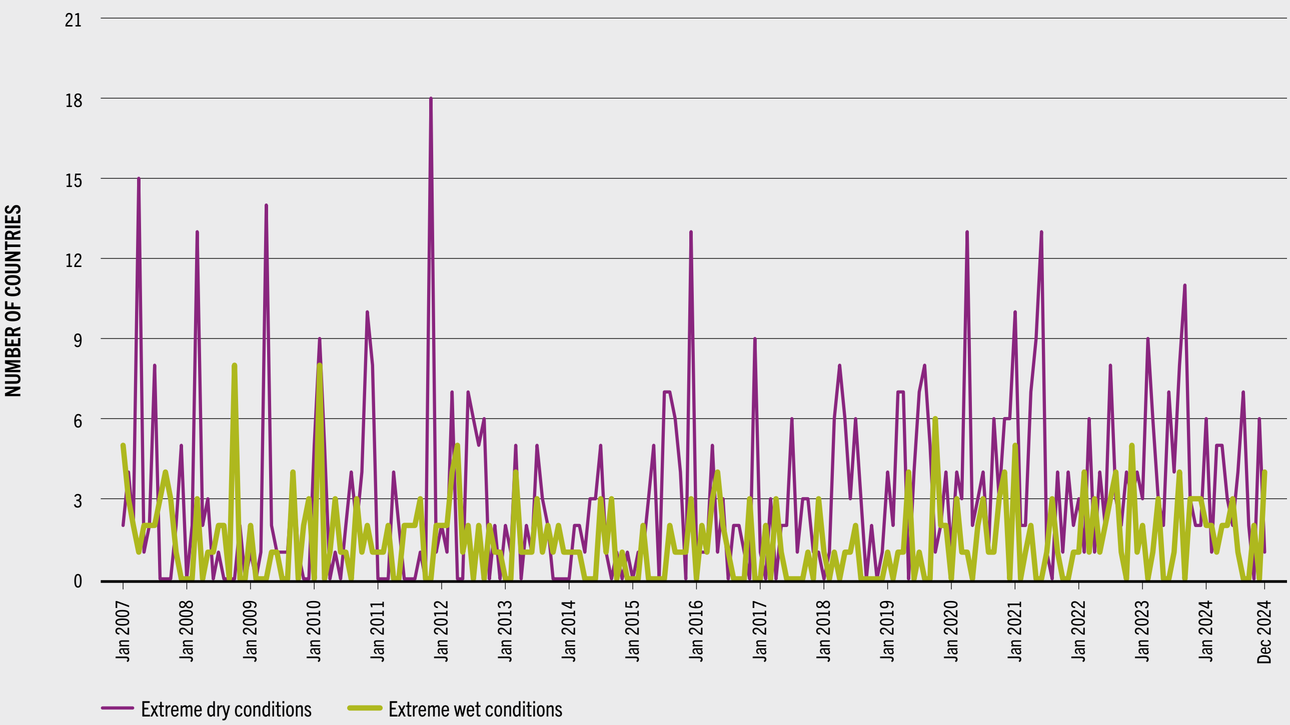
SOURCE: Authors' own elaboration based on Jafari, Y. & Heckelei, T. (forthcoming). *Weather shocks and cereal trade dynamics – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO.

» Wheat has been found to be least susceptible to dry conditions, with an estimated yield reduction of less than 25 percent under an extreme event of a 40 percent water deficit. Maize is more sensitive to dry conditions. Under a 40 percent water deficit, maize yields are estimated to reduce by around 40 percent. Anaerobic rice grown in paddy cultivation, making up for about 75 percent of global rice production, is most sensitive to dry conditions, with an estimated yield reduction of over 50 percent under a similar water deficit.[6,7,8,9] Both extreme dry and extreme wet conditions were observed frequently between January 2007 and December 2024, with dry shocks consistently affecting more countries than wet events (Figure 3.3).[10]

By lowering crop yields, together with potential impacts on transport and trade infrastructure, weather shocks can also affect trade flows. In an importing country, such disruptions reduce domestic production. To address food security concerns, the country can increase imports from the global market (see **Part 2**). Weather shocks affecting production in an exporting country reduce exports, which may negatively affect the food security of its trade partners.

A literature review on shock impacts on merchandise trade found that exports, and particularly agricultural exports, were negatively affected by high temperatures.[11] Effects on imports were found to be more heterogenous. Small low-income countries tend to experience significant detrimental effects on their export and

FIGURE 3.3 FREQUENCY OF EXTREME WEATHER EVENTS AT MONTHLY LEVEL, WORLD, JANUARY 2007–DECEMBER 2024



NOTES: Number of countries affected by extreme weather events. Extreme dry conditions defined as Standardized Precipitation Evapotranspiration Index (SPEI) below -2, extreme wet conditions defined as SPEI above 2.

SOURCE: Authors' own elaboration based on Jafari, Y. & Heckelei, T. (forthcoming). *Weather shocks and cereal trade dynamics – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO.

import flows, compared to high-income countries. For example, analysing annual merchandise trade in 170 countries during the 1962–2004 period, a study suggests that an additional shock, including natural and technological disasters, reduces bilateral imports by 0.2 percent, and exports by 0.1 percent, on average across all trade flows, with the effects varying by country size and other characteristics.[12] Nevertheless, these impacts can be transitory. Leveraging monthly data of global merchandise trade between January 1960 and December 2016, a study shows that high temperatures with a monthly average above 30 °C lead to contemporaneous export losses of around 3 percent, with trade impacts being relatively short-lived, manifesting mainly during and immediately after the shock. Unlike in food and agriculture, these effects were mainly transmitted through reduced labour productivity during hot temperatures.[13]

In food and agriculture, weather shocks have a direct impact on agricultural production and trade. In a study of major economies during the 1995–2014 period, a dry shock in a country was estimated to lead to a 70 percent increase of its aggregate crop imports, while reducing exported quantities by 48 percent. Increased rainfall, while increasing domestic production, did not significantly affect trade patterns.[14] Another study, using monthly data for the 2011–2016 period, shows that extreme weather events, particularly extreme dry and hot conditions, in exporting countries significantly affect the exports of maize, rice and soybean in the 12-month period following the crops' growing season. The effects of extreme wet conditions were found to be relatively less significant. Analysing different levels of dry and hot conditions, measured as water balance deficits, the study shows that exports respond asymmetrically – severe extreme shocks have a substantial impact, while less severe, but still extreme, conditions result in disproportionally smaller effects.[15]

Modelling weather impacts on food and agricultural trade is an emerging area of research and only a handful of studies have been published to date. Results can vary considerably based on whether researchers use annual or monthly data, focus on aggregate trade versus specific crops or employ different methods to identify weather shocks. In these exercises, the timing of weather shocks is a critical factor in quantifying effects on the resilience of food and agricultural trade. Weather shocks should be properly identified as they affect production only when they occur during the crop growing season, with their effects depending on the type and severity of the shock, crop sensitivity and growth stage. While the yield effects of a weather shock during the growing season can be assessed within weeks, trade effects generally materialize in the same marketing year – the 12 months following the harvest – with a lag ranging from a few weeks to several months. These effects can also continue in the following marketing year, with their persistence depending on whether stocks are low or policy responses amplify the shock's impact. In other cases, expectations can drive markets to react immediately after the shock – already before the harvest – with trade flows adjusting within weeks, especially for highly traded products such as cereals.

A novel econometric analysis conducted for this report helps understand the dynamics and resilience of global cereal trade in response to weather shocks (Box 3.2).[16] The results reveal some relatively consistent monthly trade patterns across wheat, maize and rice:

i. A weather shock, especially a dry shock, in an exporting country leads to an initial contraction in exports, followed by a rebound to pre-shock levels.
ii. Effects of a weather shock in an importing country are less clear-cut and often weak, as other coping mechanisms may play a role.
iii. All effects are transitory. Trade levels start rebounding within three or four months after the shock, approaching pre-shock levels within six months. However, multiple recurring shocks could have more persistent effects.

On average and across all countries, bilateral import flows react more strongly to weather shocks affecting an exporter than those originating in an importing country (Figure 3.4). For all cereals, a dry-conditions shock affecting an exporter leads, first, to a decline in exports, followed by a rebound within three or four months after the initial shock. Among the cereals, the decline in exports of maize is most profound, probably reflecting different impact thresholds (see Box 3.2) and its diverse uses in the feed and biofuel sectors that give rise to a higher price elasticity of demand, compared with wheat and rice (see Box 2.2).[17]

For wheat, averaging across all trade flows, a dry shock affecting an exporter reduces wheat imports by an importing partner country by 1.6 percent within three months. Although rebounding rapidly to pre-shock levels, a 1.6 percent reduction of wheat exports from the United States of America, for example, would still be equivalent to a loss of dietary energy needs of up to 2 million people every day. Maize imports decline immediately in response to a similar shock in the exporting country, falling by 9 percent within three months, followed by a partial rebound five months after the initial shock. The dry shock affecting a rice exporting country also tends to reduce rice imports in the partner country although this effect is less clear-cut. Maize and rice imports decline also in response to a wet conditions shock in the exporting country (by 9 percent and 0.6 percent respectively, within three months after the shock), while wheat imports increase (by 2.2 percent four months after the shock), potentially reflecting a positive yield response to wetter conditions in the exporting country. »

BOX 3.2 IDENTIFYING TRADE DYNAMICS IN RESPONSE TO WEATHER SHOCKS

In Part 2, a trade network simulation model assesses the short-term effects of hypothetical scenarios considering a major prolonged weather shock in a major exporter and concurrent extreme weather episodes worldwide with significant impacts on cereal yields. The modelling exercise in Part 3 empirically assesses the dynamic effects of past weather shocks on trade during a period of five months after the shock. The results show the average effects on bilateral trade flows of past weather shocks experienced by all exporting and importing countries worldwide.

THE ECONOMETRIC MODEL TO IDENTIFY DYNAMIC EFFECTS OF PAST WEATHER SHOCKS ON CEREAL TRADE

The econometric exercise is based on a gravity model, a standard approach used for the quantitative analysis of trade, designed to quantify the average effects of weather shocks on bilateral trade flows of wheat, maize and rice of all countries that trade these cereals worldwide. A major novelty of the model developed for this report is the use of monthly bilateral trade flows to identify the dynamic evolution of trade impacts in response to weather shocks.

The model differentiates the trade impacts of dry and wet shocks on all countries that import or export wheat, maize and rice worldwide, and utilizes data spanning from January 2007 to December 2024. As such it incorporates information on a total of 170 000 bilateral trade flows for wheat, 220 000 for maize and 330 000 for rice. The model quantifies the effects of an increase of one standard deviation in weather shocks on bilateral flows of wheat, maize and rice, averaging across all importing and exporting countries. Additional model specifications are employed to assess the role of trade connectivity and policy responses in mitigating or amplifying effects on the bilateral trade flows of the three cereals.[30]

WEATHER SHOCKS

Weather shocks are identified using the Standardized Precipitation Evapotranspiration Index (SPEI). This index incorporates information on precipitation and temperature, accounting for their combined impact on hydrological conditions through a water balance approach. The SPEI measures the intensity of dry or wet conditions relative to the historical average, normalized for better comparability across regions and climates.[31]

The SPEI information has been supplemented with data on the growing periods of each crop in each country and average historical production data to construct properly timed crop-specific weather shocks.

Estimations are run using the entire SPEI range for wet (precipitation exceeds evapotranspiration) and dry conditions (evapotranspiration exceeds precipitation) and focussing on extreme events with SPEI values above two and below minus two for extreme wet and dry conditions, respectively.[32] Wheat and rice trade impacts are robust to variations of the weather shock specifications, while maize imports are more sensitive to extreme shocks.[33] In all specifications, the effects on trade are dynamic, rebounding to the long-term trend within months of the shock. Overall, the trade effects suggest the existence of weather shock thresholds, over which trade volumes rapidly deteriorate.[34] Given that this research area is developing and studies evaluating the dynamics of weather effects on trade flows are limited, the results provide preliminary insights into potential impacts and further analysis will be required to strengthen current findings.

DYNAMIC RESPONSE TO WEATHER SHOCKS

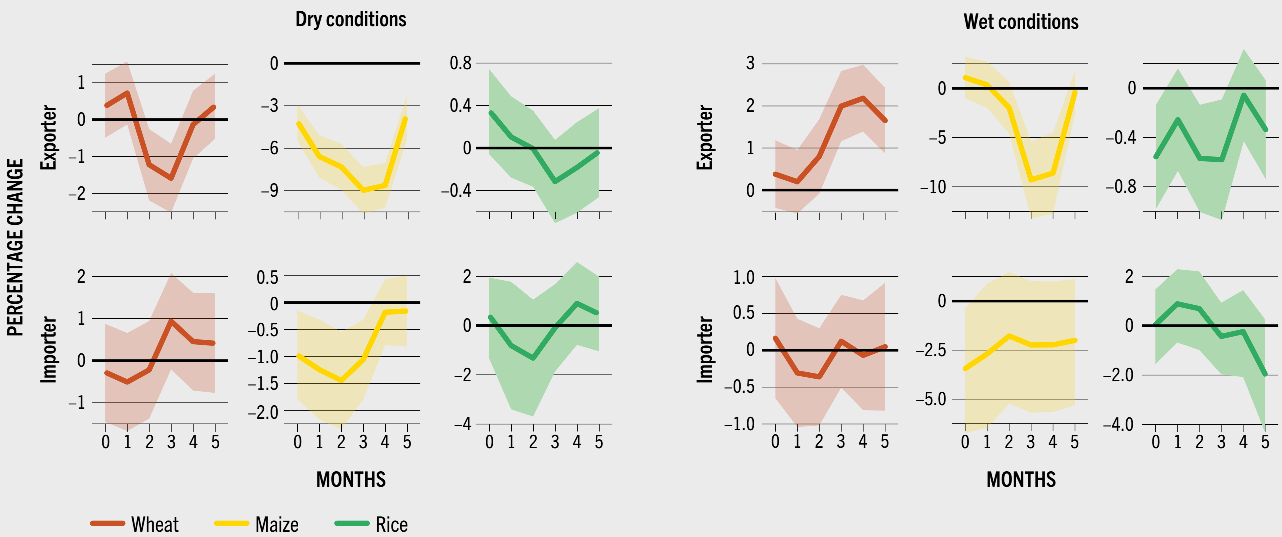
Given the novelty of this research, some uncertainty surrounds the timing of trade responses to weather shocks. While trade responses generally evolve over the marketing year, there are often only a few months between realized yields of a harvest and forming expectations for the next harvest. This would suggest that most of the trade response materializes within a period shorter than one year. Indeed, rice can be harvested multiple times in a year. While wheat and maize are only harvested once per year and per field, many countries feature two distinct growing seasons within a year determined by varying climatic conditions in different parts of the country.[35] In the analysis, most trade impacts occur in the first months after the weather shock, with trade returning to normal within half a year of the shock – a finding consistent across crops, dry and wet shocks, imports and exports, and various model specifications.

EFFECTS ON TRADE QUANTITY AND TRADE VALUE

Weather shocks can affect both traded quantity and trade value. While the effect on trade quantities reflects physical contractions or expansions of trade flows, effects on trade value are also determined by changing prices (see **Part 4**). In fact, dry conditions can significantly increase food prices already during the growing period and before any harvest failure has materialized, with expectations on the effects of weather shocks anticipating more than 80 percent of the total price impact.[36] In this analysis, the effects of weather shocks on trade were robust to whether traded quantity or trade value were considered.

SOURCES: Adapted from Jafari, Y. & Heckelei, T. (forthcoming). *Weather shocks and cereal trade dynamics – Technical note for The State of Agricultural Commodity Markets 2026*. Rome, FAO; and Heckelei, T. & Jafari, Y. 2026. *Dynamic impacts of weather shocks and trade network structures on import flows for staple commodities*. Rome, FAO. https://doi.org/10.4060/cd9503en

FIGURE 3.4 **DYNAMIC TRADE EFFECTS OF WEATHER SHOCKS ON GLOBAL AVERAGE**



NOTES: Percentage change impact of a 1-standard deviation increased weather shock on bilateral trade quantity. Shaded areas are 95 percent confidence intervals.

SOURCE: Authors' own elaboration based on Jafari, Y. & Heckelei, T. (forthcoming). *Weather shocks and cereal trade dynamics – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO.

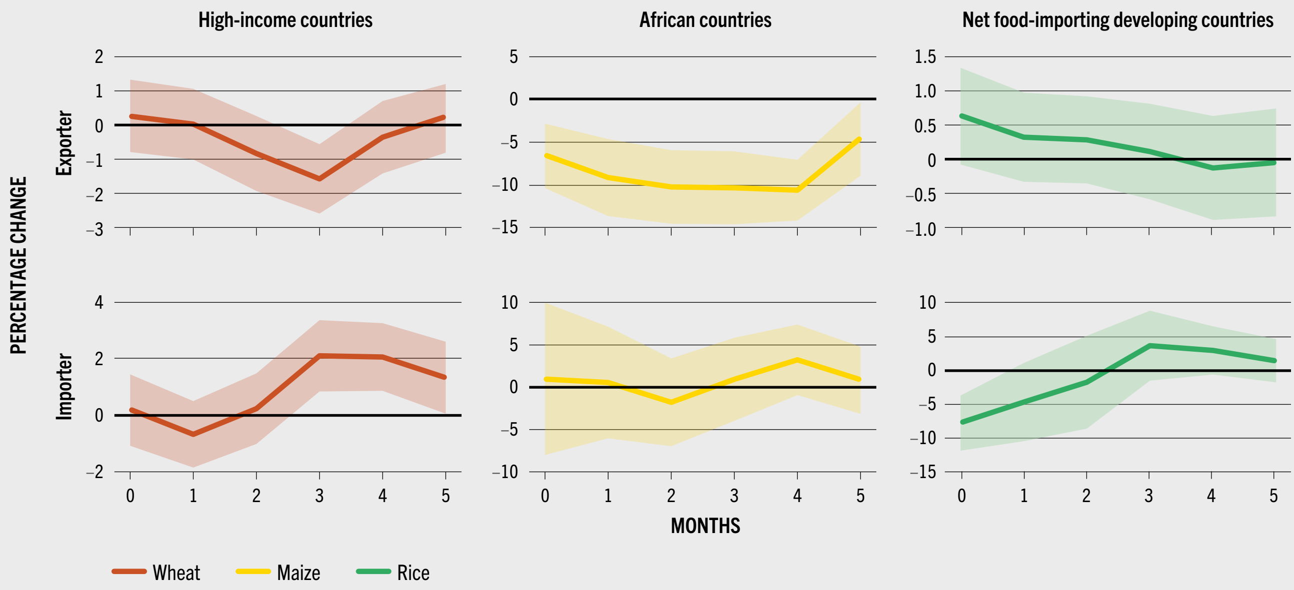
» Weather shock impacts in importing countries can vary and are, on global average, relatively uncertain, as for a country, coping mechanisms including the reduction of own exports, the use of stocks and substitution with other products could play a role (Figure 3.4).

Similar impacts and patterns are found in different country groups (Figure 3.5). For example, a dry shock in a country exporting wheat to high-income countries leads to an initial decline of imports (by 1.6 percent three months after the shock), followed by a return to original trade patterns within half a year. A dry shock affecting high-income countries leads to increasing imports to compensate for the production loss. Imports start rising within three months of the shock, reaching, on average, an increase of 2.1 percent before falling towards normal trade patterns.

A dry shock in a country exporting maize to Africa, where, for many countries, maize is a staple food, also leads to a reduction in these exports (of up to 10.6 percent, four months after the shock), while trade impacts of shocks in importing African countries are uncertain. Rice is generally less traded (see **Part 4**). A dry conditions shock affecting an exporter does not significantly impact rice imports of net food importing developing countries. A similar shock affecting a net food-importing developing country results in increased imports within three months. In all country groups and for all cereals, the results suggest that trade is relatively resilient to weather shocks, with the effects being temporary and dissipating within six months after the shock.

The average effects across global and regional bilateral trade flows demonstrate that trade responds promptly to weather shocks and typically recovers within months, pointing to a degree of resilience. However, even short-term impacts can be detrimental for food security, especially in low-income countries, with the effects being uneven across countries and population groups. Moreover, averaging over bilateral trade flows can mask substantial trade impacts at the country level (see Box 3.3). ■

FIGURE 3.5 DYNAMIC TRADE EFFECTS OF DRY CONDITIONS IN DIFFERENT COUNTRY GROUPS



NOTES: Percentage change impact of a 1-standard deviation increased weather shock on bilateral trade quantity. Shaded areas are 95 percent confidence intervals.

SOURCE: Authors' own elaboration based on Jafari, Y. & Heckelei, T. (forthcoming). *Weather shocks and cereal trade dynamics – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO.

THE ROLE OF TRADE POLICIES

Shaped by trade policies and trade agreements, a country's integration in the global market and its trade connectivity can play a key role in facilitating trade and moderating the effects of a shock on its domestic market.[18,19] For example, for importing countries affected by a weather shock, being connected to major exporters, or trade hubs, can help rapidly mitigate the impact by sourcing imports from these countries (see **Part 2**, Box 2.1). The econometric analysis shows that being connected to an exporter with many trade links, such as a trade hub, can moderate the effects of a domestic shock. Across all cereals – wheat, maize and rice – together, this moderating effect is positive, leading to increased imports by the affected country from exporters with increased trade connectivity (see Figure 3.6).[20]

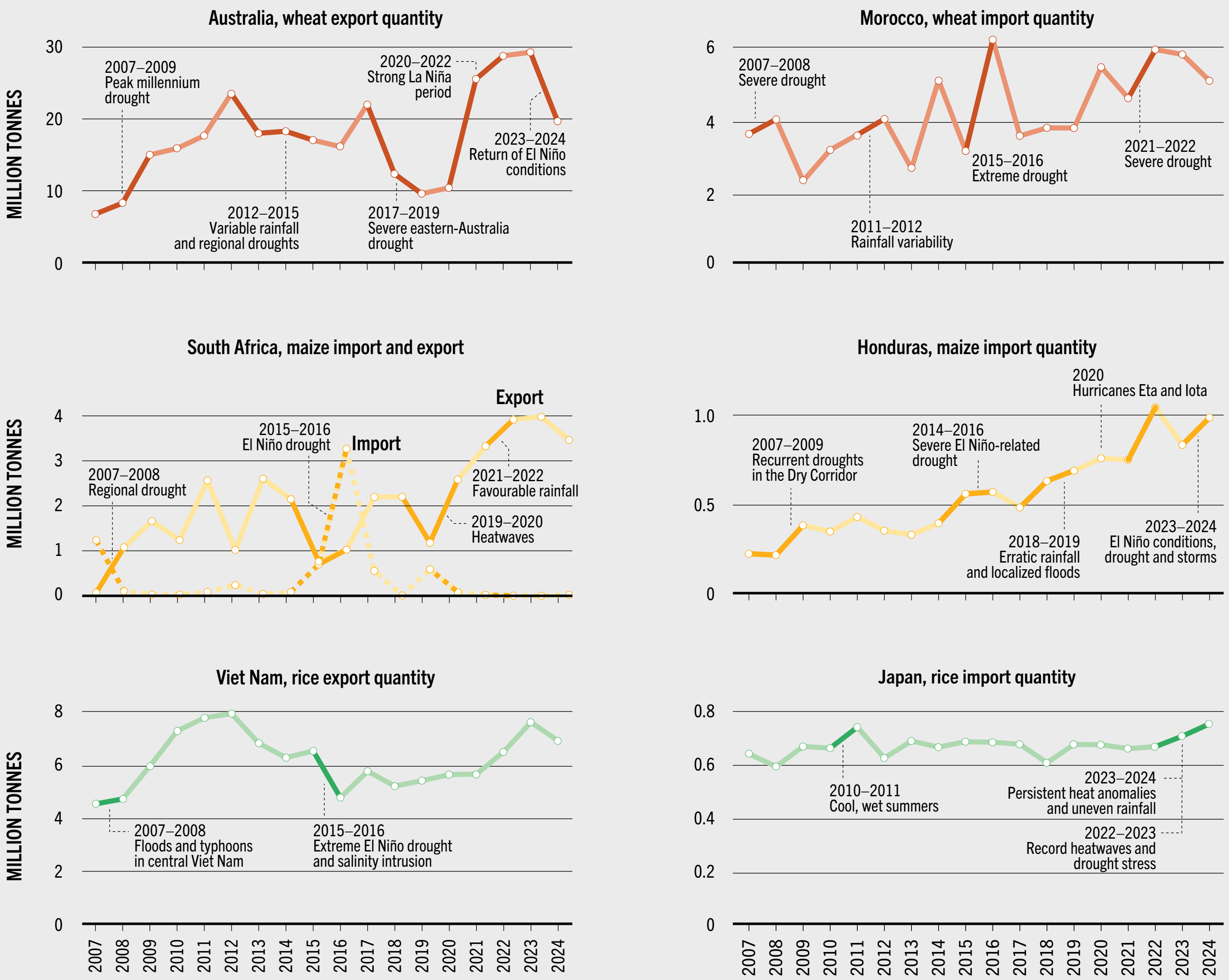
Policymakers respond to weather shocks with trade measures aiming at mitigating their effects on the availability of and access to food. Research based on data of 70 agricultural products in 76 countries has shown that, between 1985 and 2010, floods, droughts and storms led to policy changes in the aftermath of the shock. While high-income countries tended to increase protection of their agricultural sectors, mainly by increasing tariffs, trade barriers in least developed countries were reduced during periods of extreme droughts to avoid food scarcity, for example, by providing additional import subsidies.[21] Investigating the impact of rainfall shortages or droughts »

BOX 3.3 EXTREME WEATHER EVENTS AND CEREAL TRADE AT COUNTRY LEVEL

While the econometric model identifies the dynamic impacts averaged over all bilateral trade links globally, case studies can illustrate the significance of weather shock impacts at the country level.[37] Weather shocks can affect exporters and importers of different income levels and in different regions (see the Figure), sometimes followed by policy interventions to safeguard food security, especially in import-dependent countries with larger shares of low-income population groups.

In Australia, a wheat-exporting high-income country, recurring droughts, La Niña and El Niño events, and heatwaves have shaped the patterns of wheat exports between 2007 and 2024. Severe droughts in 2007–2008 and 2017–2019 reduced yields and export volumes.[38,39,40] Conversely, La Niña years such as 2010–2011 and 2021–2022 brought above-average rainfall, which, while boosting yields and exports, often compromised grain quality due to waterlogging and disease.[41]

FIGURE ASSOCIATION BETWEEN WEATHER SHOCKS AND CEREAL TRADE PATTERNS AT COUNTRY LEVEL



NOTE: Illustration of the association between weather shocks and cereal trade patterns.

SOURCES: Authors' own elaboration based on Mastroeni, A., Uzelac, L. & Savastano, S. (forthcoming). *Case studies on weather shocks, food security, and the role of trade policy in mitigation – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO; Heckelei, T. & Jafari, Y. 2026. *Dynamic impacts of weather shocks and trade network structures on import flows for staple commodities*. Rome, FAO. https://doi.org/10.4060/cd9503en; FAO. 2026. FAOSTAT: Trade – Crops and livestock products. [Accessed on 28 March 2026]. https://www.fao.org/faostat/en/#data/TCL.

BOX 3.3 (Continued)

Morocco's wheat imports surged during drought years, such as 2007–2008 and 2015–2016, to promote food security as domestic production declined.[42] Between 2018 and 2023, multiyear drought conditions and high temperatures further stressed wheat production, leading to sustained high import volumes. The Moroccan government responded by extending wheat import subsidies to stabilize food supply.[43,44] Morocco – a lower-middle-income country highly dependent on wheat imports – generally lowers or suspends wheat tariffs to facilitate imports and secure supplies to avoid price spikes when domestic supply is tight, and raises tariffs to shield local producers from import competition and to support domestic prices, usually around harvest.[45] For example, during the 2015–2016 extreme drought, wheat output fell by more than 50 percent year-on-year, triggering a doubling of wheat imports. The common-wheat duty was first reduced from 50 to 30 percent and then raised again to 65 percent as conditions normalized.[46] During the prolonged dry period 2018–2023 and the 2022 extreme drought, tariffs were temporarily suspended to ease import flows when domestic output was constrained, for example, in early 2020 and November 2021, then raised again when production recovered (notably in May 2021, up to 135 percent for common and 170 percent for durum wheat).[47,48]

In South Africa – traditionally a maize exporter – maize exports fluctuated due to droughts, heatwaves and favourable rainfall. The 2007–2008 regional drought reduced maize yields and constrained export volumes. Export volumes also dropped during the 2015–2016 El Niño drought and 2019–2020 heatwaves. Especially the 2015–2016 El Niño drought, one of the worst in decades, severely impacted maize-growing provinces, leading to a sharp decline in exports and the temporary consideration of maize imports.[49] Conversely, the 2021–2022 season benefited from favourable rainfall, resulting in a bumper harvest and increased maize exports to neighbouring Southern African countries.[50]

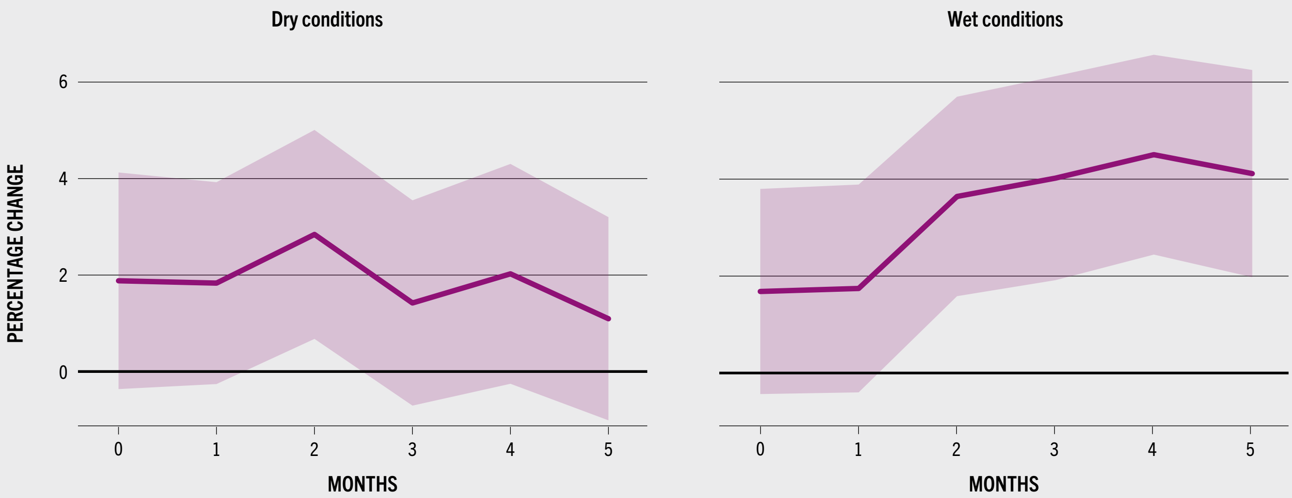
Honduras, already a net-food importing developing country, where maize is the main staple food, increased its maize imports following recurrent droughts in 2007–2008, a severe El Niño-related drought in 2014–2016, and erratic rainfall and localized floods in 2018–2019. In response to the 2014–2015 El Niño drought-reduced output, the government allowed larger maize purchases at a zero tariff from outside the Central American region to mitigate production shortfalls and secure availability.[51] At the end of 2020, hurricanes Eta and Iota, the most severe hurricanes to hit Honduras in more than 20 years, destroyed parts of Honduras's maize harvest, necessitating emergency assistance and leading to significantly increased maize imports.[52] In 2023–2024 maize imports increased again driven by El Niño-related droughts and storms.

Viet Nam, a major exporter of rice, reduced its export volumes several times in response to weather shock impacts on rice production. Floods and typhoons in 2007–2008, including a 1-in-100-years flood event in 2007, contributed to government concerns over domestic supply, leading to rice export restrictions during the 2007–2008 global food price crisis.[53,54] In 2015–2016, an extreme El Niño drought – the worst drought in Viet Nam in 90 years – and salinity intrusion led to a sharp reduction in exportable surplus.[55] However, despite severe production losses, Viet Nam did not impose formal quantitative export restrictions on rice.

In Japan, a record-breaking heatwave in 2023 and prolonged high temperatures during the 2023 and 2024 growing seasons significantly reduced production quality, marking the beginning of a "rice crisis".[56,57,58] With demand outpacing production since 2021–2022, rice prices rose and import demand increased. Rice is a staple food in Japan, carrying considerable social, cultural and policy sensitivity, with a strongly regulated market maintaining the self-sufficiency rate at close to 100 percent. A state trading system quantitatively restricts imports and private imports are subject to high tariffs.[59,60] Nonetheless, a study using a panel dataset of 46 Japanese prefectures from 2000 to 2024, found that, despite the strongly regulated market, El Niño and La Niña episodes can substantially disrupt domestic rice market prices, while imports help ease supply pressures.[61]

SOURCES: Adapted from Mastroeni, A., Uzelac, L. & Savastano, S. (forthcoming). *Case studies on weather shocks, food security, and the role of trade policy in mitigation – Technical note for The State of Agricultural Commodity Markets 2026.* Rome, FAO; Heckelei, T. & Jafari, Y. 2026. *Dynamic impacts of weather shocks and trade network structures on import flows for staple commodities*. Rome, FAO. https://doi.org/10.4060/cd9503en

FIGURE 3.6 RELEVANCE OF EXPORTERS' OUTWARD CONNECTIVITY ON MODERATING IMPACTS OF A SHOCK IN THE IMPORTING COUNTRY



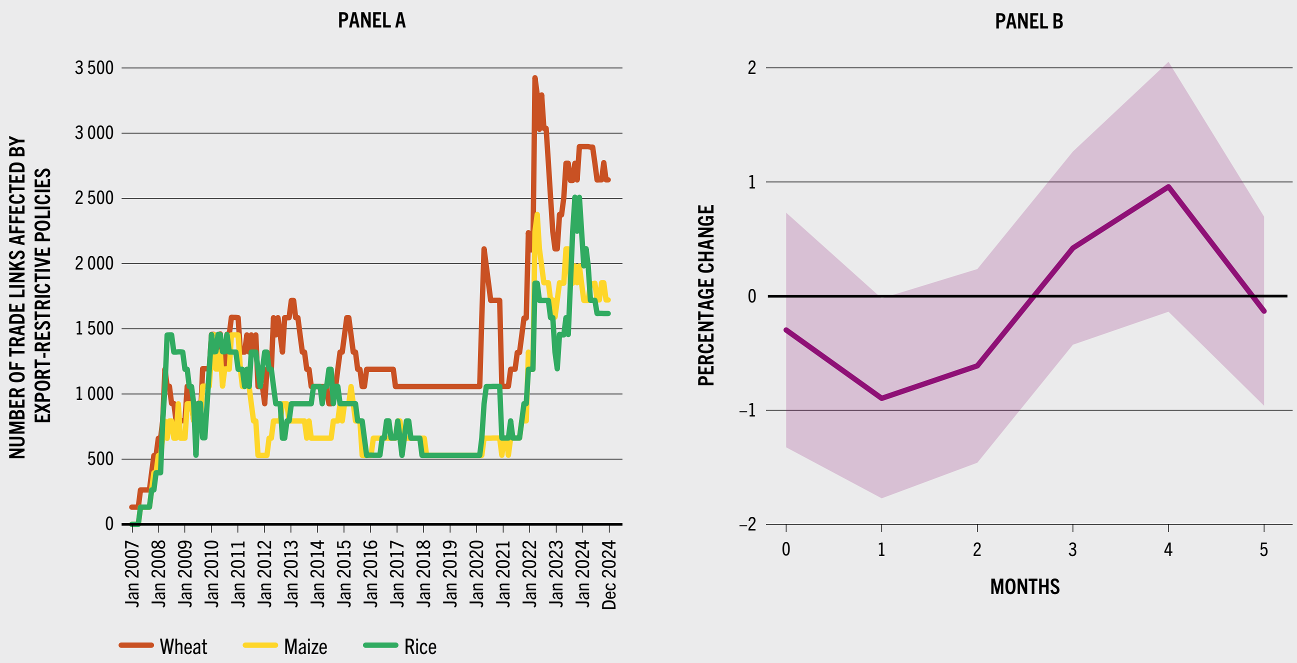
NOTES: Combined effect of weather shock impacts in the importing country with the outward connectivity of the exporting partner (interaction term) on bilateral import value of wheat, maize and rice. Shaded areas are 95 percent confidence intervals.

SOURCE: Authors' own elaboration based on Heckelei, T. & Jafari, Y. 2026. *Dynamic impacts of weather shocks and trade network structures on import flows for staple commodities*. Rome, FAO. https://doi.org/10.4060/cd9503en

» on applied tariffs across 70 countries over the 1988–2006 period, a study found that rainfall shortages generally led to lower applied tariffs on agricultural imports, while larger volumes of rainfall are associated with higher agricultural tariffs.[22] In addition, weather shocks occurring during the negotiation phase of trade agreements have also been found to correlate strongly with the size of negotiated tariff cuts. Weather shocks that enhance a country's capacity to produce certain crops tend to be associated with smaller tariff cuts, while those that decrease a country's production capacity correlated with larger tariff reductions.[23]

However, policy responses to shocks directly affect trade patterns. To shield their markets from world food commodity price spikes following a shock, countries often resort to export-restricting and import-facilitating measures (see **Part 4**).[24] The repercussions of these measures on global markets depend on the number of trade links affected and the volume traded through these links. Together with increasing connectivity in the cereal trade networks (see **Part 2**), the number of trade links that are affected by policy interventions has increased since 2007. For example, the number of links affected by export restrictions increased during the periods associated with the 2007–2008 food price crisis, the 2010–2012 period of excessive food price volatility, the COVID-19 pandemic in 2020 and the beginning of the war in Ukraine in 2022 (see Figure 3.7, **Panel A**). The empirical analysis suggests that export restrictions are associated with an almost instantaneous decline in imports by the importing partner (Figure 3.7, **Panel B**). However, export-restrictive policy interventions are often short-lived and import volumes tend to increase in subsequent months to offset initial declines. Trade patterns generally return to their previous state within six months following such policy changes.[25]

FIGURE 3.7 ESTIMATED NUMBER OF BILATERAL CEREAL TRADE LINKS AFFECTED BY EXPORT-RESTRICTIVE POLICIES AND CORRELATION WITH BILATERAL IMPORT VALUES ACROSS WHEAT, MAIZE AND RICE



NOTES: Export-restrictive policies include export bans, quotas and taxes. For the analysis, the removal of export promotions and export subsidies are also included. With increasing bilateral trade links, the number of links affected by policy measures can increase (**Panel A**). **Panel B**: Association between export-restrictive policies imposed by the exporting country and bilateral import values of wheat, maize and rice combined. Shaded areas are 95 percent confidence intervals.

SOURCE: Authors' own elaboration based on Heckelei, T. & Jafari, Y. 2026. *Dynamic impacts of weather shocks and trade network structures on import flows for staple commodities*. Rome, FAO. https://doi.org/10.4060/cd9503en

By reducing trade volumes in the global market, export restrictions can lead to rising prices, with the announcement of trade policy changes already increasing price volatility.[26,27] Export restrictions directly harm importing partners in the short term and distort domestic markets and incentives, thus hampering productivity growth in the longer term (see **Part 4**).[28,29] Market intelligence (see Box 1.1) and international cooperation can help address concerns over the effects of shocks on food security. The powerful impact of international cooperation on resilience in the face of severe trade disruptions has been demonstrated during the COVID-19 pandemic (Box 3.1) and at the beginning of the war in Ukraine (Box 3.4). ■

BOX 3.4 MULTILATERAL COOPERATION CAN FOSTER MARKET RESILIENCE

The outbreak of the war in Ukraine at the end of February 2022 led to a sudden halt of exports from Ukrainian Black Sea ports and to concerns over the availability of exports from the Russian Federation. This sent a shockwave through global markets, with the FAO Food Price Index hitting 159.3, its highest ever value, in March 2022. Among other commodities, global wheat imports from Ukraine decreased substantially between March and July 2022 compared to the same months in 2021 (see the Figure).

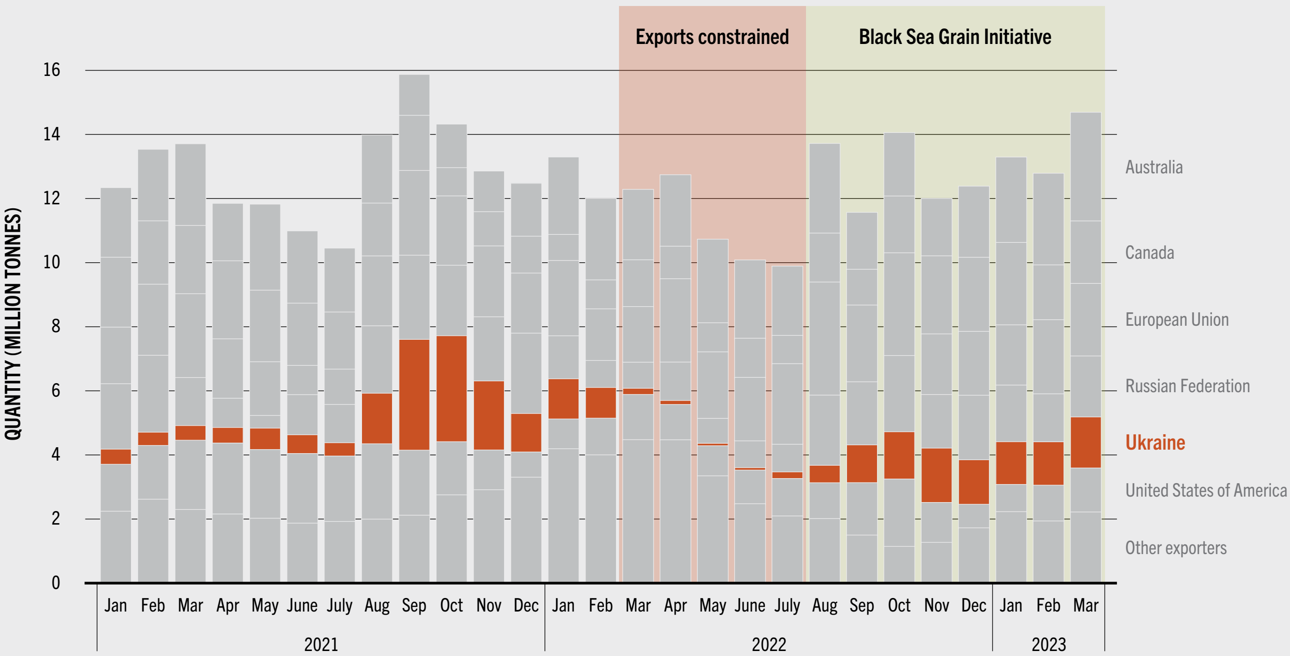
The United Nations Secretary-General's swift action helped restore an important trade route, providing a timely market solution. With successful mediation by the United Nations and Türkiye, two agreements were signed in Istanbul on 22 July 2022, jointly referred to as the Istanbul Agreements. The Initiative on the Safe Transportation of Grain and Foodstuffs from Ukrainian Ports, commonly referred to as the Black Sea Grain Initiative (BSGI), provided a framework for the resumption of exports from three key Ukrainian Black Sea ports through a safe maritime humanitarian corridor. The agreement was in place from July 2022 through July 2023. The initiative made a key contribution to market stability. The Memorandum of Understanding between the Russian Federation and the Secretariat of the United Nations on promoting Russian food products and fertilizers to the world markets, commonly referred to as the Memorandum of Understanding (MoU), provided assurances that the Russian Federation's exports of food and fertilizer would not be impeded by measures imposed upon the Russian Federation. It had a duration of three years.* To implement the Black Sea Grain Initiative, a Joint Coordination Centre (JCC) was established in Istanbul, comprising senior representatives from the Russian Federation, Türkiye, Ukraine and the United Nations.[62]

The resumption of grain and oilseed exports under the Black Sea Grain Initiative increased predictability and global food prices came down almost instantly. Between August 2022 and July 2023, the BSGI exported a total of 32.9 million tonnes of foodstuffs, of which 57 percent were destined for developing countries, many of which were located in Africa and the Near East regions.[63] The initiative also increased the availability of grain supplies for humanitarian assistance in Afghanistan, Yemen and the Horn of Africa.

NOTE: * Ammonia exports did not resume under the signature of these agreements.

SOURCE: Adapted from FAO, WTO & World Bank. 2023. *Rising Global Food Insecurity: Assessing Policy Responses. A report prepared at the request of the Group of 20 (G20).* Rome, FAO. https://openknowledge.fao.org/server/api/core/bitstreams/2f7d11db-dad5-442e-934d-836d7cec2723/content

FIGURE GLOBAL WHEAT IMPORTS FROM UKRAINE AND OTHER MAJOR SUPPLIERS, JANUARY 2021 TO MARCH 2023



SOURCE: Authors' own elaboration based on FAO. 2023. *The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine.* Information Note, 3 July 2023 Update. Rome.

TAJIKISTAN
An FAO-supported wheat breeding trial site.
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PART 4
THE IMPACTS OF SHOCKS ON FOOD PRICES

SUMMARY

Part 4 examines how various shocks affect world food commodity prices and highlights how trade and other policies shape the transmission of price signals between global and domestic food markets. It examines whether trade policy responses can insulate domestic markets from the impact of a shock, and how these policies can amplify or mitigate price spikes in the global markets. The role of public stockholding policies in addressing food price increases is also discussed.

KEY MESSAGES

➔ Food commodity prices are inherently volatile. Their long-term trend is interrupted by violent spikes caused by shocks, such as weather extremes and conflicts, which can have a persistent impact as they affect the fundamental forces of supply and demand. These price spikes are not matched by downward price movements. Macroeconomic factors and business cycles further contribute to price fluctuations.

➔ Shocks to global food commodity markets give rise to significant price effects. The lower the buffer capacity of a market, the higher the price spike. Trade expansion can contribute towards global markets that are more resilient to shocks.

➔ Surges in world cereal prices can transmit to domestic markets, driving food insecurity and adverse nutrition outcomes. High prices of cereals constrain the purchasing power of poor households, leading to reduced consumption and diminished diversity and quality of diets.

➔ In the event of a shock, trade policies by major players aiming to insulate domestic markets, test the resilience of global food commodity markets. Export restrictions withdraw supplies from the global market, while import facilitation strengthens demand. This further exacerbates the shock's effect on world prices to higher levels.

➔ Food stocks are an integral component of resilience strategies. Maintaining large buffer stocks to stabilize domestic prices has proven to be highly costly and fiscally unsustainable. At the global level, similar efforts have failed. Smaller emergency food reserves, integrated to social protection safety nets targeting the vulnerable, can effectively address food insecurity without distorting markets.

Food prices lie at the heart of our food systems and sustainable development – access to and affordability of food are central to human existence, food security, nutrition and health. Food prices provide incentives for farmers on what and how much to produce, given the available production technology. Together with preferences and incomes, prices guide consumers' decisions and shape the composition of diets. They also drive investments in food and agriculture, and embody the scarcity of natural resources, such as land, water or biodiversity, thereby shaping the environmental footprint of agriculture. ■

THE DYNAMICS OF FOOD COMMODITY PRICES

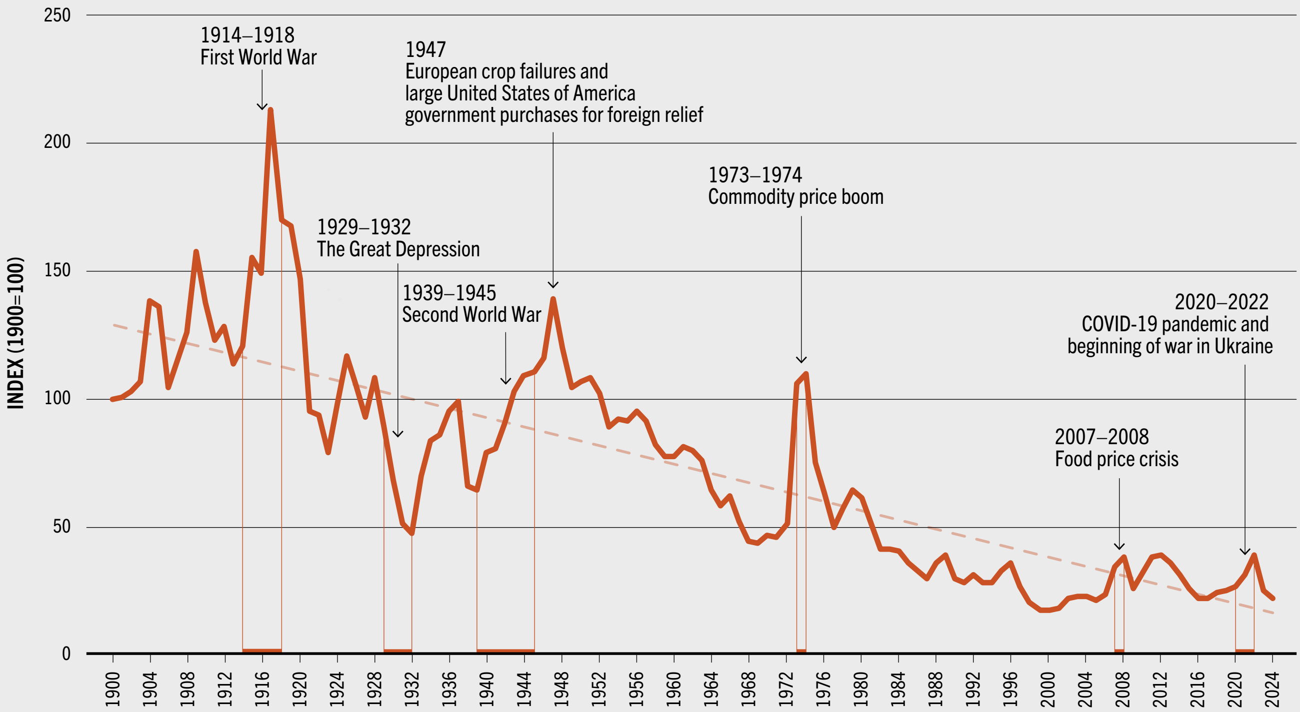
In global markets, food commodity prices are determined by many factors, including the fundamental forces of supply and demand, with weather shocks, pests and diseases, and conflicts generating significant price fluctuations. Prices are also influenced by the macroeconomic environment, with monetary policies, exchange rates and speculative activities playing an increasingly important role, along with the agricultural and trade policies of major exporting and importing countries.

All these factors shape the dynamics of food prices and give rise to a number of distinguishing characteristics:

- Food commodity prices follow a **secular decline** as compared with manufactures (see Figure 4.1). Although, the existence of such long-term negative trends is controversial, there are reasons that can explain the decline in commodity prices.[f] Global demand for primary commodities is inelastic with respect to income. An increase in income would result in a proportionally lower increase in the demand for food commodities, thus putting pressure on prices, as compared to manufactures for which the demand reacts more strongly to changes in income.[1]
- Food commodity prices are inherently and significantly **volatile**. Their long-term trend is interrupted by violent spikes and volatility spells (Figure 4.1 shows several price episodes). In the short term, because elasticities of supply and demand with respect to price are low, even small changes in supply (due to weather shocks or conflicts, for example) require a large change in price to balance supply and demand, especially when stocks are low. For example, the 2007–2008 global food price crisis had its origins in such fundamental factors – poor wheat harvests in Australia in 2006 and 2007 due to severe drought, reduced grain harvest in Europe, in conjunction with low global grain stocks and increased and sustained demand by emerging economies, especially China (see Figure 1.2).[2]
- Food commodity prices are linked across years, as traders build inventories by buying when prices are low and selling when prices are high. This behaviour can smooth prices. However, shocks have a persistent impact, often lasting over one year due to the biological nature of agricultural production.[3] High prices influence farmers' expectations about the future price level, but production can only be increased with a significant lag. This generates price cycles in the medium term – higher production leads to a new lower price, which increases the demand for food, giving rise to a medium-term sequence of **boom-bust-boom behaviour** (for example, the behaviour of wheat prices between 1974 and 1980, see Figure 4.1). Nevertheless, evidence suggests that the violent upward price spikes that are driven by market fundamentals are not matched by the downward spikes and prices.[4]
- Longer-term cyclical patterns can also be observed around the overall downward trend. Globally, there is a long-term relationship between economic activity and commodity prices. Business cycles – the expansion, peak and contraction of economic activity – can give rise to **super-cycles** in food commodity prices. For example, world economic growth, led by

f The secular decline of relative primary commodity prices was observed in the 1950s by economists Raul Prebisch and Hans Singer (and named the Prebisch–Singer hypothesis). Their work became the focus of trade and development economists and gave rise to a substantial number of econometric studies that aimed at testing the existence of a long-term negative trend in commodity prices relative to manufactures. See for example, Hallam, D. 2017. *Revisiting Prebisch–Singer: what long–term trends in commodity prices tell us about the future of CDDCs – Background paper to the UNCTAD-FAO 2017 Commodities and Development Report.* Rome, FAO; and Lee, J., Islam, M.T., Tieslau, M., Payne, J.E. & Nazlioglu, S. 2025. Trends of relative commodity prices with comovements and structural breaks. *Journal of International Money and Finance*, 103474. https://doi.org/10.1016/j.jimonfin.2025.103474

FIGURE 4.1 **WHEAT REAL PRICE INDEX, 1900–2024**



NOTES: The figure depicts an historical wheat price index series deflated by the manufactures unit value from 1900 to 2024. The series follows a long-term downward trend, with prices being volatile around this trend. Identification of shocks by authors.

SOURCE: Authors' own elaboration based on Jacks, D.S. 2019. From boom to bust: a typology of real commodity prices in the long run. *Cliometrica*, 13(2): 201–220. https://doi.org/10.1007/s11698-018-0173-5

the United States of America and Western Europe up to the outbreak of the First World War, was followed by a sharp downturn culminating in the Great Depression in the early 1930s (Figure 4.1). In the beginning of the twenty-first century, rapid economic growth in emerging economies gave rise to another cycle that contributed to the food commodity price increases in 2008.[g,5]

- Different commodity prices tend to move together, even if these commodities are unrelated. Prices of food commodities, such as wheat and maize, **co-move**, as these foods are close substitutes in demand and have similar production costs. Agricultural and energy markets are connected. As fuel is an input to agriculture and some crops, such as maize or sugarcane, are used for the production of biofuels, prices of oil and ethanol can co-move with those of food commodities.[6,7] Nevertheless, prices of commodities that are unrelated in terms of production or demand also tend to co-move, especially during periods of significant changes in economic activity.[8] Such co-movement may be related to super-cycles and could be due to expansionary monetary policy that can drive up commodity prices.[9,10] Other analysts suggest that it is the financialization of commodities that result in such a synchronous movement in prices. (see Box 4.1).[11,12] ■

g See Erten, B. & Ocampo, J.A. 2013. Super cycles of commodity prices since the mid-nineteenth century. *World Development*, 44: 14-30. https://doi.org/10.1016/j.worlddev.2012.11.013

BOX 4.1 ARE FOOD COMMODITIES FINANCIALIZED?

Futures markets facilitate the transfer of price risk between commercial and non-commercial traders. In food and agriculture, commercial traders, such as producers and processors of food and agricultural commodities, utilize futures contracts to hedge against the risk of fluctuating prices. Non-commercial traders, such as speculators, operate in futures markets primarily to earn a risk premium by assuming the price risks that commercial traders seek to hedge.

In the 2000s, financial investors, who traditionally focused on equities, bonds and short-term securities, became increasingly active in commodity futures contracts, mainly as instruments for financial portfolio diversification, especially for hedging against inflation. This new group of traders – called commodity index speculators – operate by taking positions on various commodities simultaneously. Their strategies are based on identifying trends in futures prices and expecting these trends to continue, rather than on the underlying (supply and demand) fundamentals.

As the volume of trade attributable to index speculators increased dramatically, concerns were raised that index-based investments could distort prices away from market fundamentals and contribute to the food price spikes and volatility observed in 2007–2008. Indeed, data from the United States Commodity Futures Trading Commission (CFTC) in 2006 showed that the trading volumes in the wheat futures market exceeded the level of physical wheat production.[66] Trend-following behaviour associated with index-based investment was also cited as a potential driver of the strong co-movement of commodity prices that are seemingly unrelated, such as metals and agricultural commodities, but also for the co-movement of commodities with equity markets.

The role of commodity index-based investment in agricultural price movements is widely debated. Reviews of empirical studies analysing trader positions and futures and cash prices find no clear evidence that index investment directly drove agricultural futures prices.[67] Similarly, analyses of 28 agricultural commodity markets during the 2008 food price crisis identified only a few short-lived price "bubbles", suggesting that index investors did not detach prices from market fundamentals.[68]

Some research, however, finds that commodity index investment contributed to greater co-movement of commodity prices, with indexed commodities becoming more correlated with financial assets and with each other after 2004.[69] Other studies indicate that while financialization may strengthen these linkages, macroeconomic factors, particularly global business cycles, play a greater role, with index investment potentially reinforcing effects during periods of high liquidity.[70,71]

Well-regulated and transparent derivatives markets remain essential for facilitating effective risk management and price discovery, with demonstrated capacity to mitigate price volatility under typical market conditions. The debate on the role of commodity index investors prompted international efforts to enhance the transparency, oversight and integrity of commodity derivatives markets.

The International Organization of Securities Commissions (IOSCO) developed global regulatory principles for promoting greater position transparency (through mandatory reporting), tighter position limits, enhanced market surveillance, regulation of central counterparties, improved risk management practices and cross-border regulatory coordination.

These principles informed national regulatory reforms such as the Dodd-Frank Act in the United States, which expanded the CFTC's mandate to reinforce commodity market oversight and implemented reforms to improve transparency and market integrity.[72,73] The European Union implemented the IOSCO principles through the Markets in Financial Instruments Directive and the European Market Infrastructure Regulation, introducing stricter rules to enhance transparency and oversight. These include position limits, reporting requirements and transparency measures such as weekly reporting of hedged and non-hedged positions. The 2022 price spikes following the onset of the war in Ukraine triggered liquidity pressures due to increased margin calls, prompting the Financial Stability Board to assess financial stability risks in commodity markets. While the systemic impact remained limited, the episode highlighted structural vulnerabilities related to credit, liquidity and data availability.[74]

TRADE AND WORLD FOOD COMMODITY PRICES

Countries engage in trade by leveraging their comparative advantage. They export foods that they can produce relatively more efficiently (at a lower opportunity cost) and import those that are relatively more expensive to produce domestically. Differences in productivity and the uneven distribution of natural resources, such as land and water, determine comparative advantage and drive specialization in food production.[13]

For individual countries, participation in trade creates economic gains, as resources are allocated more efficiently. However, on a global scale, trade can influence the long-term level of world food prices. In a well-functioning and competitive global market, countries that enjoy comparative advantage and are specialized in food production can expand production for export and lower global average production costs, contributing, in the long term, to lower world food prices, as compared to a situation where markets are fragmented or uncompetitive.[14]

In a similar line, trade can help stabilize food prices in the short term, both domestically and globally. In the event of a shock resulting in production shortfalls and high prices in the domestic market, trade acts as a buffer. Such fluctuations can be effectively smoothed down by adjustments in imports or exports, increasing availability, stabilizing domestic prices and promoting food security (see **Part 3**).

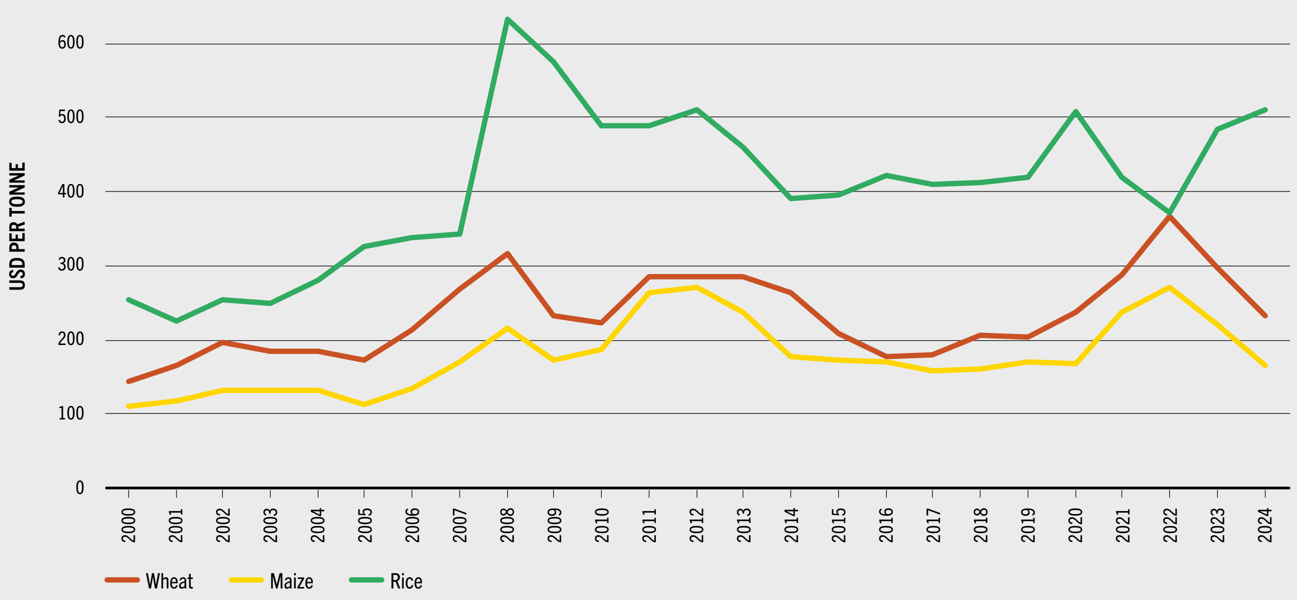
At the global level, high trade intensity markets – that is markets with many participating countries, where a significant share of global production is traded – are resilient and tend to cancel out shocks that are specific to individual regions of the world, resulting in less variable global supplies and contributing towards more stable world prices.[15] However, in markets with low trade intensity, even small shocks can generate wide price variation. For example, in the 2007–2008 food price crisis, real prices in the rice market, where about 7 percent of global production was traded, increased significantly by 88 percent, compared with the 2005–2007 average. Unlike rice, in wheat markets, where the share of global production that was traded amounted to about 22 percent, real prices increased by 45 percent (Figure 4.2).

Since the beginning of the new millennium, the globalization of food and agriculture has accelerated (see Figure 1.1). Today, more countries trade with each other, and the expanded global markets have become integral parts of our food systems, strengthening the resilience to shocks.[16] The impact of trade expansion on world prices is apparent when examining data over an extended period. Figure 4.3 shows the long-term relationship between price volatility and a liquid market, using real prices for wheat and global cereal trade between 1850 and 2016. From 1850 and until the end of the Second World War, low volumes of global trade coincide with pronounced price volatility. However, as trade expanded during the period 1947–2016, prices, on average, become less variable with fewer spikes of lower amplitude.

While expanded trade and increased integration in global food and agricultural markets strengthen countries' resilience to domestic shocks and build up the buffer capacity of global markets, at the same time they increase countries' exposure to systemic shocks – such as major weather shocks or conflicts that affect important market players. Such shocks can propagate through the trade network resulting in significant price fluctuations in both global and domestic markets with important implications for food security and the economies of food net-importing low-income countries (see also **Part 2**).

Between 2020 and 2022, two major and compound shocks – the COVID-19 pandemic and the war in Ukraine – triggered sharp increases in world food commodity prices, further amplified by rising energy costs. While world rice prices peaked in 2020 due to export restrictions prompted by the pandemic, other world food commodity prices started rising in mid-2020, driven by fiscal and monetary policies, aiming to counter the severe economic contraction caused by the pandemic (Figure 4.2). While the global »

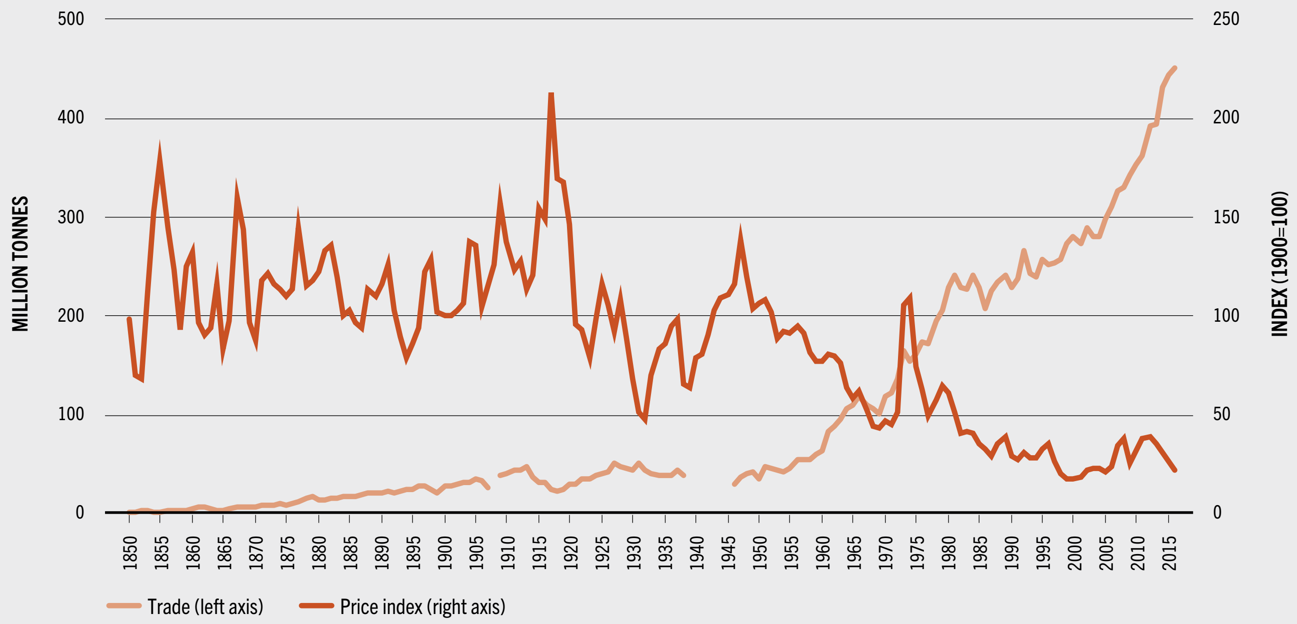
FIGURE 4.2 WHEAT, MAIZE AND RICE PRICES, 2000–2024 (REAL)



NOTES: Wheat (United States of America), No. 2 Hard Red Winter Gulf export price, Maize (United States of America), No. 2, yellow, FOB, United States of America Gulf ports, Rice (Thailand), 5 percent broken, white rice, milled.

SOURCE: Authors' own elaboration based on World Bank. 2026. Commodity Price Data: The Pink Sheet. [Accessed on 12 March 2026]. https://www.worldbank.org/en/research/commodity-markets

FIGURE 4.3 WHEAT REAL PRICE INDEX AND WORLD CEREAL TRADE, 1850–2016



NOTE: Index of real wheat prices and volume of cereal trade, measured in million tonnes during the period 1850–2016.

SOURCES: Authors' own elaboration based on Jacks, D.S. 2019. From boom to bust: a typology of real commodity prices in the long run. *Cliometrica*, 13(2): 201–220. https://doi.org/10.1007/s11698-018-0173-5; Krausmann, F. & Langthaler, E. 2019. Food regimes and their trade links: A socio-ecological perspective. *Ecological Economics*, 160: 87–95. https://doi.org/10.1016/j.ecolecon.2019.02.011

BOX 4.2 THE IMPACTS OF THE COVID-19 PANDEMIC AND THE WAR IN UKRAINE ON WORLD FOOD COMMODITY PRICES

Between 2020 and 2022, global food commodity prices experienced significant swings, driven by a complex interplay of demand- and supply-side shocks. With the outbreak of the COVID-19 pandemic, on average, and despite the multiple challenges presented by the lockdowns and mobility restrictions, food and agricultural trade proved remarkably resilient.[75] To counter the significant contraction of economic activity, governments implemented large-scale fiscal support programmes and adopted expansionary monetary policies, including direct income support aimed at addressing income and employment losses, and significant interest rate cuts, quantitative easing programmes and emergency liquidity provisions that allowed the financial sector to continue to supply credit to households and businesses. Globally, the level of fiscal support measures put in place to mitigate the COVID-19 pandemic economic downturn was unprecedented. Between January 2020 and September 2021, countries announced or implemented a capital injection of nearly USD 17 trillion into the global economy.[76]

In 2022, as the global economy was recovering from the pandemic, the war in Ukraine resulted in ripple effects, driving food commodity prices higher. At that time, the Russian Federation and Ukraine had a combined market share of 34 percent for wheat, 26 percent for barley, 17 percent for maize and 75 percent for sunflower oil.[77]

Analysis undertaken for the 2025 edition of *The State of Food Security and Nutrition in the World* shed light on the contribution of different drivers to food commodity price movements during the 2020–2022 period, suggesting that market fundamentals, monetary expansion, the war in Ukraine and energy prices all played an important role.

At the onset of the pandemic, concerns about farmers' ability to harvest their crops, due to labour shortages, placed upward pressure on world food prices. Export restrictions imposed by some food-exporting countries, although they were short-lived, added to the pressure. Together, it is estimated that these drivers added about 15 percentage points to food prices during the early months of 2020 (see the Figure, **Panel A**).

In late 2020 and during 2021, food prices continued to rise, this time driven by the COVID-19 pandemic fiscal support measures that stimulated demand. Monetary expansion put additional pressure on prices, as lower interest rates strengthened inventory demand for storable food commodities, resulting in further price increases (see the Figure, **Panel A**). Monetary expansion also triggers expectations for an increase in the inflation rate. This results in investors moving away from liquid assets towards other investments including commodities, with the latter "overshooting" their long-term equilibrium price level and increasing proportionally more than the general price level in the short term.[78]

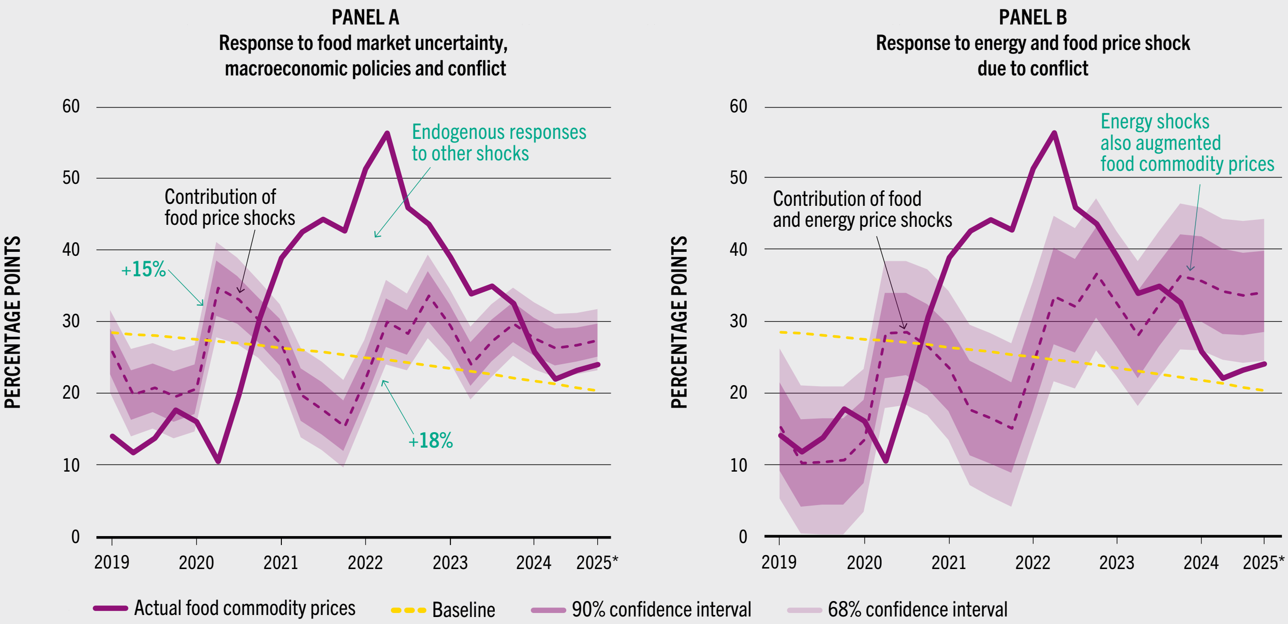
In a second phase, in 2022, the war in Ukraine and geopolitical tensions disrupted critical trade corridors in the Black Sea and Red Sea regions. These disruptions, together with increases in the price of fertilizers, due to substantial declines in fertilizer exports from the Russian Federation, resulted in food commodity prices increasing by an additional 18 percentage points (see the Figure, **Panel A**). The war in Ukraine also affected energy markets, as the Russian Federation, at that time, was the second-largest producer of oil and natural gas. These energy price shocks added to the pressure on food commodity prices peaking at a contribution of 11.5 percent in 2024 (see the Figure, **Panel B**).[79]

SOURCE: Adapted from FAO, IFAD, UNICEF, WFP & WHO. 2025. *The State of Food Security and Nutrition in the World 2025 – Addressing high food price inflation for food security and nutrition*. Rome, FAO. https://doi.org/10.4060/cd6008en

» economy started its recovery process, the outbreak of the war in Ukraine in February 2022 disrupted supply routes for major grains and energy, pushing world prices sharply upwards (see Box 4.2). Such global food commodity price shocks were transmitted into domestic markets, with low-income countries experiencing the highest rates of food price inflation, reaching up to 30 percent and placing a disproportionate burden on the poorest.[17] ■

BOX 4.2 (Continued)

FIGURE DECOMPOSITION OF GLOBAL FOOD COMMODITY PRICES FLUCTUATIONS



NOTES: Food commodity prices are a trade-weighted index of benchmark prices for key food commodities, including cereals, vegetable oils, meat, sugar, bananas and oranges. Energy commodity prices comprise a weighted average of global crude oil, natural gas and coal prices. See Peersman, G. 2025. *Understanding the post-COVID-19 pandemic surge in food price inflation – Background paper for The State of Food Security and Nutrition in the World 2025.* FAO Agricultural Development Economics Working Paper 25-06. Rome, FAO. * Data are available through December 2024.

SOURCE: Adapted from FAO, IFAD, UNICEF, WFP & WHO. 2025. *The State of Food Security and Nutrition in the World 2025 – Addressing high food price inflation for food security and nutrition.* Rome, FAO. https://doi.org/10.4060/cd6008en

GLOBALIZATION AND VULNERABILITY: HOW ARE GLOBAL SHOCKS PROPAGATED TO DOMESTIC FOOD COMMODITY PRICES?

Three questions arise when considering world food commodity price spikes. First, how do shocks affect world prices? Second, are fluctuations in world prices transmitted to domestic markets? Third, what would shape the extent of this pass-through? High world prices of staple foods – such as wheat, maize and rice – can have significant impacts on food security and poverty, especially in low-income countries where households spend a large share of their income on food. In net food-importing developing countries, price shocks increase food import bills and can negatively affect the balance of payments, foreign currency reserves and limit social safety programmes (see Box 1.4).

FAO estimates that between 2019 and 2024, the prevalence of severe food insecurity increased by 3.5 percentage points in low-income countries experiencing the highest rates of food price inflation.[18] During the same period, a study on Papua New Guinea suggested that a 25 percent increase in the world price of rice would reduce total rice consumption by an average of 14 percent in the country.[19] When staple prices increase, poor net food-buying households face a direct reduction in real purchasing power, and as a coping strategy, they reduce the quality of their diets. During the 2007–2008 food price crisis, in Afghanistan, wheat flour price increases resulted in reductions in dietary diversity, with the most

BOX 4.3 THE EFFECTS OF FOOD PRICE SHOCKS ON WOMEN

The prevalence of food insecurity remains consistently higher among women than men, globally and in all regions.[80] Empirical evidence consistently indicates that productivity gaps between men and women reflect unequal access to land, inputs and services, and that when granted equal access, women's productivity converges with, or in some cases exceeds, that of men.[81,82]

Gender imbalances have important implications for women's food security when shocks occur. Evidence from Ethiopia shows that, on average, female-headed households were more likely to report a food price shock in 2007–2008 than male-headed households. The research, which compares seven rounds of male and female-headed household panel data, finds that female-headed households are consistently more vulnerable to food price shocks.[83] The study also notes that owning larger or more productive plots of land had a protective effect on households when food price shocks occur – with these being typically owned by male-headed households. As such, a food price shock reinforces existing structural disadvantages.

Research drawn from household surveys in Bangladesh and Uganda estimates changes in asset values for jointly owned assets, husband-owned assets and wife-owned assets and shows that shocks – floods, droughts, illness and death – impact asset accumulation differently.[84] Risk is not equally pooled within households, and shocks affect intrahousehold asset distributions, with long-term implications for bargaining power, resilience and poverty dynamics, particularly for women. The direction and magnitude of these effects are context-dependent, reflecting differences in local gender norms, asset portfolios and livelihood systems. Overall, shocks tend to increase intrahousehold gender asset inequality, particularly through the erosion of women's individually owned assets. Women's vulnerability is expressed through losses in smaller, more liquid assets, such as livestock, marginal land or jewellery, which tend to be sold first. The findings imply that analyses focusing solely on household-level asset dynamics may mask important gender-specific poverty traps.

vulnerable households reducing the consumption of vegetables, fruits, sugars and oils to maintain calorie intake, potentially resulting in long-term health consequences.[20] In Burkina Faso, both dietary diversity and household food security were significantly reduced.[21] In addition to food price spikes, price volatility can also have significant impacts. For example, in sub-Saharan Africa, an increase in unexpected volatility of maize prices in the year after birth increases the odds of stunting for children under 5 years of age by 9 percent.[22] The effect of food staple price spikes on women is also asymmetric, affecting women and men differently, often exacerbating inequalities (see Box 4.3). At the same time, high prices can benefit poor net food-sellers. A study on poverty rates, food price changes and food production growth for 33 middle-income countries during the 2000–2019 period shows that increases in the price of food are associated with reductions in the poverty headcount, except in predominantly urban countries or countries with relatively small agricultural sectors. Increased production, as a result of higher prices as well as higher unskilled labour wages in rural areas, contributed to poverty reduction.[23]

The globalization of food and agricultural markets implies that major shocks tend to generate significant effects in domestic markets (see also **Part 2**). Research undertaken for this report quantifies the average velocity and magnitude at which weather shocks, affecting the world prices for wheat, maize and rice, propagate and pass through to markets in selected countries, and assesses whether these shocks are mitigated or amplified by trade policies.[24,h]

Figure 4.4 shows that the weather shock on the world maize price is persistent, decaying over time but remaining positive for approximately six to seven months. In Colombia, this shock affects the yellow maize price in the capital, Bogotá, showing a strong propagation through

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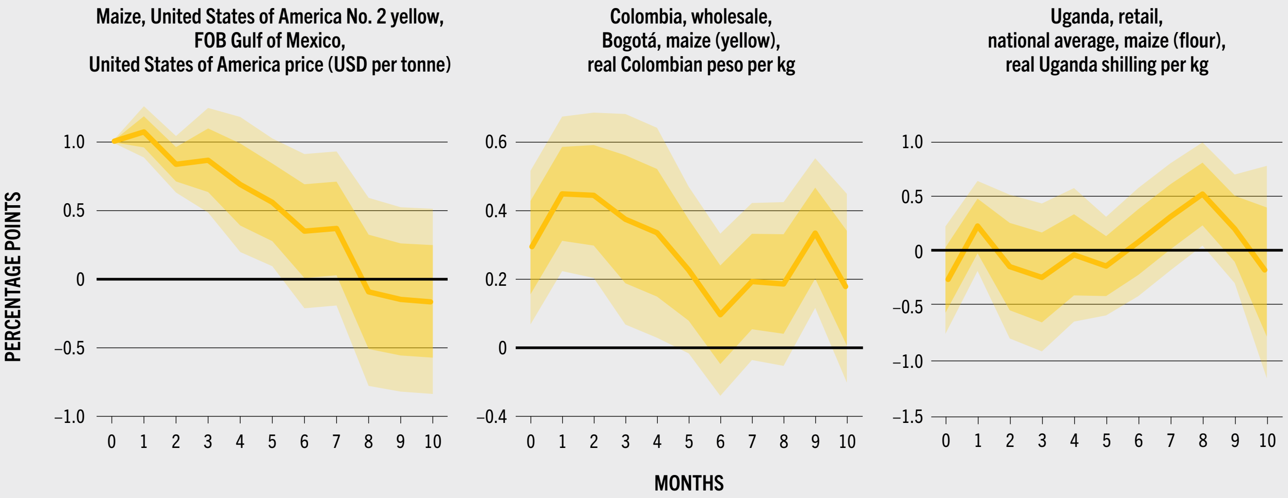
h The research is based on local projection models estimated using monthly data on world prices and domestic prices in several countries. The methodology relied on isolating the impact of weather shocks, measured by mean temperature and cumulative precipitation, that are unrelated to domestic prices and other macroeconomic drivers. The dynamic propagation of the weather shock on domestic prices is reflected by impulse response functions (IRFs) that show how an unexpected shock affects the world price (the impact is normalized to one percentage point increase) and other domestic prices over time. IRFs trace the dynamic time-path of prices in response to a one-time "impulse" or shock. See Figures 4.4 and 4.5.

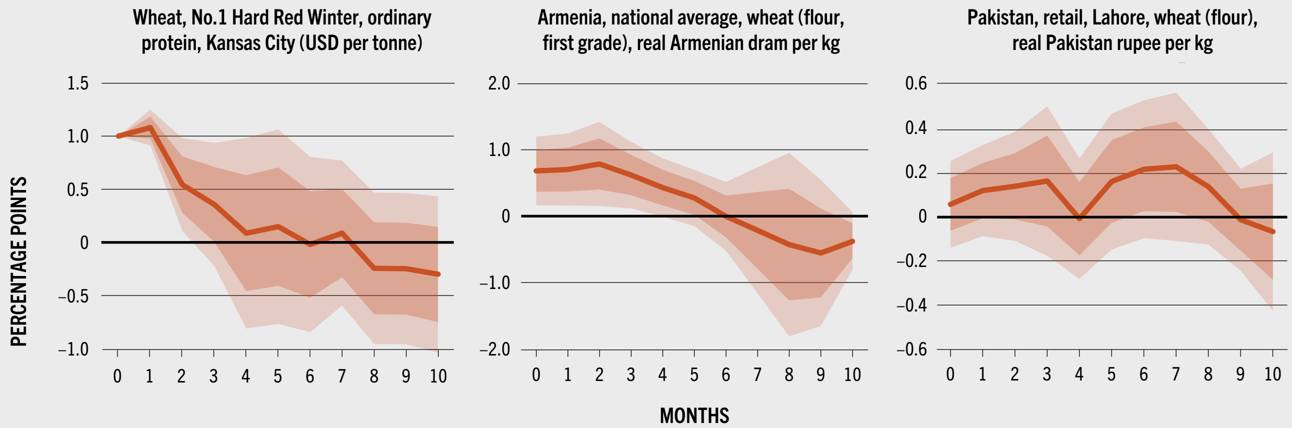
FIGURE 4.4 PROPAGATION OF A WEATHER SHOCK RESULTING IN A 1 PERCENTAGE POINT INCREASE IN THE WORLD MAIZE PRICE IN THE MARKETS OF COLOMBIA AND UGANDA



NOTES: World maize price (maize, United States of America No.2 yellow, FOB Gulf of Mexico) response to a one-time weather shock (normalized to a 1 percentage point increase) and domestic maize price responses in Colombia and Uganda. Shaded areas are 68 percent (dark shade) and 90 percent (light shade) confidence intervals.

SOURCE: Lucidi, F.S. (forthcoming). *Local food prices and the international price disruption – Background paper for The State of Agricultural Commodity Markets 2026*. Rome, FAO.

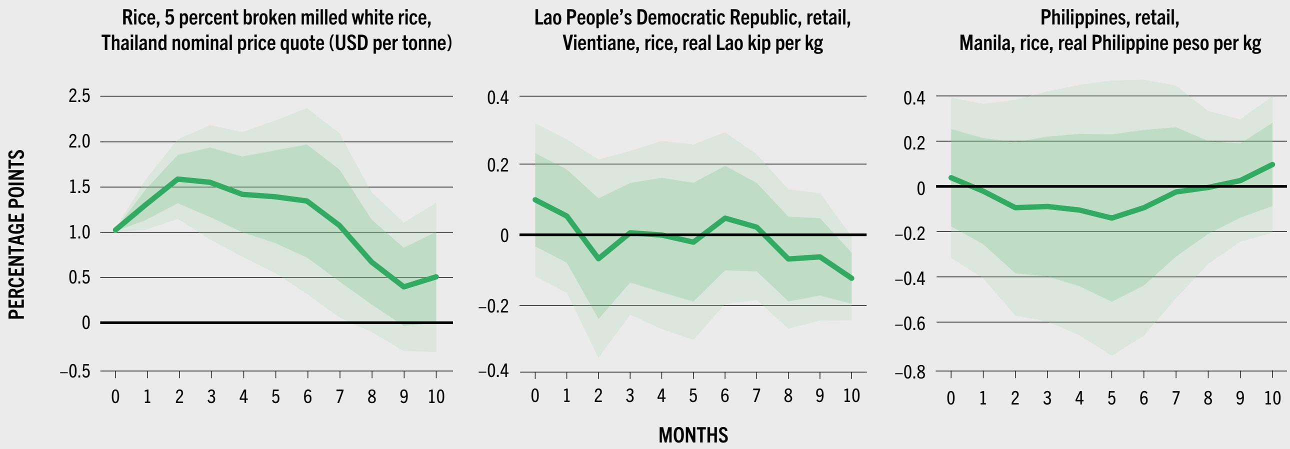
FIGURE 4.5 PROPAGATION OF A WEATHER SHOCK RESULTING IN A 1 PERCENTAGE POINT INCREASE IN THE WORLD WHEAT PRICE IN THE MARKETS OF ARMENIA AND PAKISTAN



NOTES: World wheat price (wheat, No.1 Hard Red Winter, ordinary protein, Kansas City) response to a one-time weather shock (normalized to a 1 percentage point increase) and domestic wheat flour price responses in Armenia and Pakistan. Shaded areas are 68 percent (dark shade) and 90 percent (light shade) confidence intervals.

SOURCE: Lucidi, F.S. (forthcoming). *Local food prices and the international price disruption – Background paper for The State of Agricultural Commodity Markets 2026*. Rome, FAO.

FIGURE 4.6 **PROPAGATION OF A WEATHER SHOCK RESULTING IN A 1 PERCENTAGE POINT INCREASE IN WORLD RICE PRICE IN THE MARKETS OF THE LAO PEOPLE'S DEMOCRATIC REPUBLIC AND THE PHILIPPINES**



NOTES: World rice price (rice, 5 percent broken milled white rice, Thailand nominal price quote) response to a one-time weather shock (normalized to a 1 percentage point increase) and domestic maize price responses in the Lao People's Democratic Republic and the Philippines. Shaded areas are 68 percent (dark shade) and 90 percent (light shade) confidence intervals.

SOURCE: Lucidi, F.S. (forthcoming). *Local food prices and the international price disruption – Background paper for The State of Agricultural Commodity Markets 2026*. Rome, FAO.

» the ten months horizon. The Colombian maize market is characterized by low trade barriers with imports supplying approximately 80 percent of the country's total maize consumption.

In Uganda, the impact is small and uncertain, with some effects being realized eight months after the shock, reflecting a slow and weak propagation in the domestic maize flour market (Figure 4.4). Although trade policies in Uganda promote a liberalized and export-orientated maize sector, the integration with the global market is, generally, weak. Uganda – a landlocked country facing high trade costs – is better connected to regional markets, such as Kenya. Therefore, the Ugandan maize price is more responsive to shocks affecting regional trade hubs, with global maize market shocks having a delayed effect.[25]

A weather shock affecting wheat world prices results in a sharp impact but less persistent propagation. Compared with maize, the global wheat market absorbs the shock's impact relatively rapidly within two months (Figure 4.5). In Armenia – a country with a high cereal import dependency rate amounting to 75 percent – the response to the shock is relatively large on impact but short-lived, reflecting a strong but transitory pass-through. Armenia's wheat market is relatively well-integrated with the Black Sea wheat export market, especially the Russian Federation which is the country's main wheat supplier. Trade policies aim at import diversification, but also at ensuring food security through frequent wheat export bans to countries outside the Eurasian Economic Union, that could weaken the linkages with the global market.[26]

In Pakistan, prices of wheat flour respond to the shock slowly, with this effect being weak and decreasing over time (Figure 4.5). On average, this points to a weak propagation and a small pass-through of the shock to domestic markets.

Since the 1970s, the government has intervened in the wheat market to stabilize prices through public buffer stock operations. Procurement and releases of wheat by the buffer stock prevent extreme price fluctuations in the domestic market, while guaranteeing farmers a minimum return through a minimum support price and providing wheat to millers at subsidized prices.[27] Export bans of wheat and wheat flour, as well as import tariffs are also used to insulate the domestic market.

For the global rice market, the analysis suggests that a weather shock results in a large, significant and persistent response by the world rice price (Figure 4.6). Rice prices react to the shock, increasing within two months with the impact declining but remaining positive over the time horizon. The global rice market, being characterized by low trade intensity, cannot easily absorb shocks, resulting in wide variations in prices.

In the Lao People's Democratic Republic and the Philippines, the response to the shock is short-lived and very small in magnitude (Figure 4.6). The Lao People's Democratic Republic is self-sufficient in rice but has extensive export controls that, at times, keep domestic prices low relative to world prices. Trade policies include an import tariff on paddy rice and an elaborate system of import and export permits, where traders must register with both the national and provincial governments. Removing export controls, for example in the case of a bumper harvest, can increase exports and put significant upward pressure on the domestic price of rice.[28] In the Philippines – the world's largest importer of rice – since the 1980s and, until 2019, the National Food Authority (NFA) has had monopoly over rice imports and, through buffer stock procurement and releases at administratively set prices, has maintained the domestic rice price level above world prices.[29] ■

WORLD FOOD COMMODITY PRICE SPIKES: THE IMPACT OF NON-COOPERATIVE TRADE POLICIES

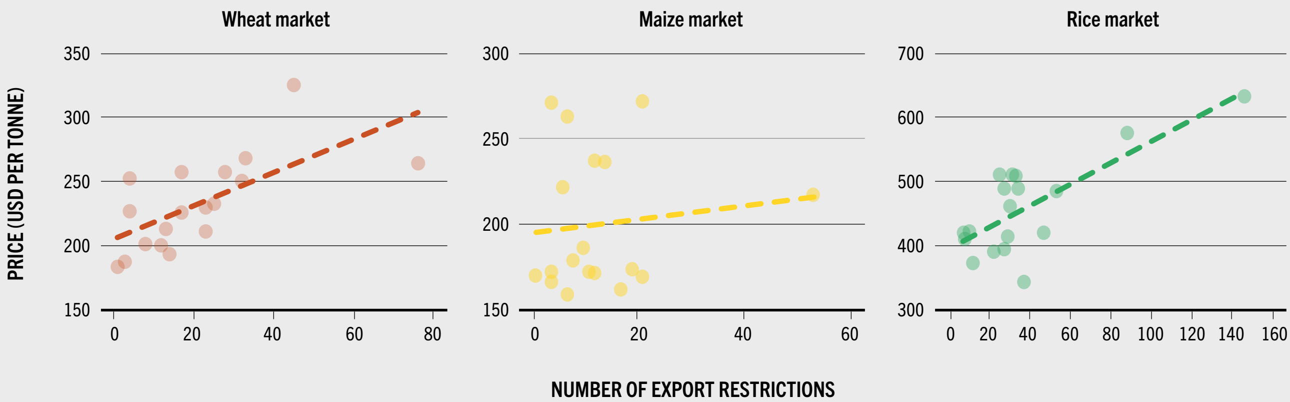
Analysing the propagation of weather shocks on world and domestic prices reveals two important points. First, the effects of a shock differ across different global food commodity markets in terms of both magnitude and persistence, with high trade intensity markets being capable of absorbing the shock's effects quickly. Second, the impacts on domestic food markets are heterogeneous with trade policies shaping the extent to which the shock propagates across countries. These points indicate a complex relationship between trade policies and world food prices.

When world food commodity prices surge, some countries resort to trade policies to shield their domestic markets, limit the increase in domestic prices and mitigate possible short-term impacts on food security. Exporting countries apply export restrictions, while importing countries reduce import barriers to partly offset the pass-through of the increase in the world price in their markets. Such policies insulate domestic markets, increase the availability of food in the country and lower domestic food prices relative to the world market.

Export restrictions result in an increase in the domestic food supply and a decline in domestic food prices, benefiting consumers. However, they imply a tax on farmers, which lowers the incentive to increase production and discourages investment, with negative implications for food security in the long term. Such measures can lower farm income and reduce the rural wages of unskilled workers having a more immediate impact among farming communities. For example, it is estimated that maize export bans in the United Republic of Tanzania would result in 210 000 rural households falling below the poverty line in maize surplus regions, compared with a free export scenario.[30]

In addition, export restrictions can affect the world price, depending on whether the countries that implement them are important players in the

FIGURE 4.7 RELATION OF WORLD FOOD COMMODITY PRICES AND EXPORT RESTRICTIONS IMPOSED BY COUNTRIES, 2007–2024



NOTES: Export restrictions include export prohibitions, export quotas, export taxes, licensing requirements, minimum export prices and restrictions on customs clearance points for exports. Data is collected from the Organisation for Economic Co-operation and Development (OECD) database on Export Restrictions on Staple Crops, which covers Agricultural Market Information System countries, which include G20 members, permanent guests, and eight additional major exporting and importing countries of wheat, maize, rice and soybeans. For further information see OECD. 2024. *Export Restrictions on Staple Crops Since 2007: An overview based on the OECD database on export restrictions on staple crops.* OECD Food, Agriculture and Fisheries Papers N°210. Paris, OECD Publishing. https://doi.org/10.1787/ccfa8a95-en

SOURCE: Authors' own elaboration based on World Bank. 2026. Commodity Price Data: The Pink Sheet. [Accessed on 12 March 2026]. https://www.worldbank.org/en/research/commodity-markets; and OECD. 2026. Export Restrictions. [Accessed on 12 March 2026]. https://www.oecd.org/en/topics/sub-issues/agro-food-trade/export-restrictions-on-staple-crops.html

world market. Figure 4.7 shows that the number of export restrictions imposed by countries on wheat, maize and rice during the 2007–2024 period is positively related to prices in the world market, suggesting that when prices surge, more countries restrict their exports to stabilize domestic prices, or, conversely, the more countries apply export restrictions the higher the world prices (see Box 4.4 for the WTO disciplines on export restrictions).

As major food-exporting countries impose export restrictions, they decrease the volume of food exports to the global market. At the same time, large food-importing countries, by reducing their import barriers to mitigate the world food price pass-through in their markets, increase import demand. As a result, such countercyclical policy responses put further pressure on the world price, as they reduce the capacity of the global market to act as a buffer and restore equilibrium by sharing the impact of the shock among many countries.[31,32]

Trade-policy-induced increases in world food commodity prices are likely to lead other countries to restrict their exports or promote their imports, resulting in a "multiplier effect" further amplifying world price spikes and deteriorating global market resilience. An analysis of trade measures across 77 countries and 32 food products for the period 2008–2011, found evidence of such a multiplier effect on world market prices. Such non-cooperative trade policy behaviour across countries results in withdrawing supplies from the global markets, while at the same time, renders import demand inelastic to price changes.[33]

More export restrictions were introduced during the 2007–2008 food price crisis than during the COVID-19 pandemic and the war in Ukraine (Figure 4.8). While rice and wheat were the most targeted staple foods during the 2007–2008 crisis, exports of wheat and maize were subject to more restrictions during the pandemic and the beginning of the war in Ukraine.[34]

BOX 4.4 WORLD TRADE ORGANIZATION DISCIPLINES FOR EXPORT RESTRICTIONS

In the context of an external shock, such as a weather extreme or conflict, that affects global food markets, many countries resort to countercyclical trade policies to insulate their domestic markets and safeguard the availability and affordability of food. Using trade policies to stabilize food prices is attractive to policymakers, as they are easier to implement and less costly than other measures such as public food stockholding. Nevertheless, the widespread use of export restrictions, and especially export bans, can amplify the impact of the shock on world prices and test the resilience of global food markets.

Under the World Trade Organization (WTO) disciplines, quantitative restrictions on exports are generally prohibited by Article XI of the General Agreement on Tariffs and Trade (GATT) 1994 Agreement but an exception allows governments to prohibit or restrict exports on the condition that these measures are "[…] temporarily applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party."[85] Export prohibitions or restrictions relating to foodstuffs must also conform with the provisions of the Agreement on Agriculture that requires WTO members to give due consideration to the effects of such prohibition or restriction on importing members' food security, give notice in writing, as far in advance as practicable to the Committee on Agriculture, and consult, upon request, with other WTO members having a substantial interest as an importer. These disciplines, however, do not apply to developing country members, unless the measure is taken by a developing country member that is a net food exporter of the specific foodstuff concerned.[86]

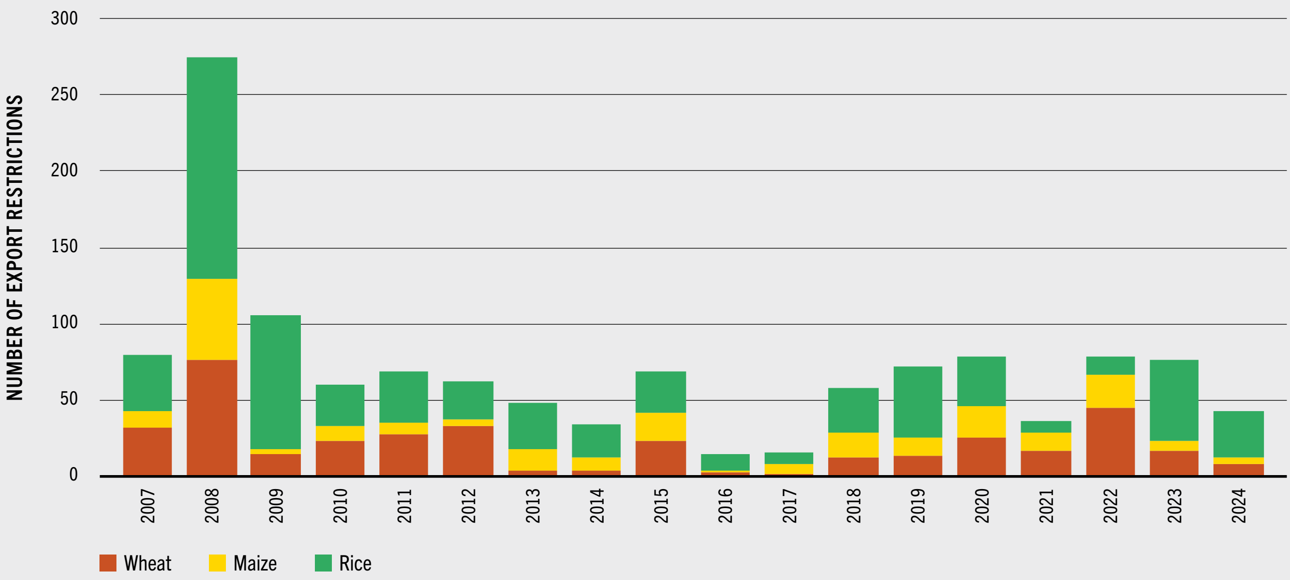
In 2011, in the context of a prolonged period of high food price volatility in global markets, FAO, together with other international organizations in a policy report to the Ministers of Agriculture of the Group of Twenty (G20), underlined both the need to keep trade in food and agriculture functioning and the detrimental effect export restrictions could have on the global market, and recommended strengthening international disciplines on export restrictions.[87] Similar proposals were forwarded by food-importing WTO members, such as the Republic of Korea and Switzerland, that are concerned about their vulnerability to export restrictions.[88,89] Despite these proposals, the asymmetry between WTO disciplines on export restrictions and import restrictions that are bound, remains. However, the fact that export restrictions during the COVID-19 pandemic were short-lived and affected a smaller share of exports compared with the 2007–2008 food price crisis is encouraging.

Nevertheless, during the COVID-19 pandemic, export restrictions were relatively short-lived. In the 2007–2008 period, export restrictions affected more than 16 percent of globally traded calories, while those implemented during the first months of the pandemic affected around 8 percent.[35]

Analysis shows that changes in trade policies contributed substantially to the increases in world prices of staple foods during the 2007–2008 food price crisis. Insulating policies affecting the global rice market are estimated to explain 45 percent of the increase in the world rice price, while approximately 30 percent of the increase in the world price of wheat can be attributed to changes in border protection rates.[36] In a similar line, another study focusing on a broader range of food commodities during the 2008–2011 period suggests that a 20 percent increase in trade restrictions globally resulted in an increase in food prices by between 22 percent and 56 percent.[37]

Many analysts suggest that these policies may not be effective in stabilizing prices, especially when adopted by many countries. Export restrictions and import promotion measures amplify world price increases, giving rise to the multiplier effect with more countries introducing policies to insulate their markets, further exacerbating the effect on world prices, thus reducing the effectiveness of these interventions in stabilizing domestic prices.[38] Indeed, if importing countries increase their imports while exporting countries decrease their exports by an equivalent amount, the effect on domestic prices in both groups

FIGURE 4.8 NUMBER OF EXPORT RESTRICTIONS IMPOSED BY COUNTRIES ON WHEAT, MAIZE AND RICE, 2007–2024



NOTES: Export restrictions include export prohibitions, export quotas, export taxes, licensing requirements, minimum export prices and restrictions on customs clearance point for exports. Data is collected from the Organisation for Economic Co-Operation and Development (OECD) database on Export Restrictions on Staple Crops which covers Agricultural Market Information System countries, which include G20 members, permanent guests, and eight additional major exporting and importing countries of wheat, maize, rice and soybeans. For further information see OECD. 2024. *Export Restrictions on Staple Crops Since 2007: An overview based on the OECD database on export restrictions on staple crops.* OECD Food, Agriculture and Fisheries Papers N°210. Paris, OECD Publishing. https://doi.org/10.1787/ccfa8a95-en

SOURCE: Authors' own elaboration based on OECD. 2026. Export Restrictions. [Accessed on 12 March 2026]. https://www.oecd.org/en/topics/sub-issues/agro-food-trade/export-restrictions-on-staple-crops.html

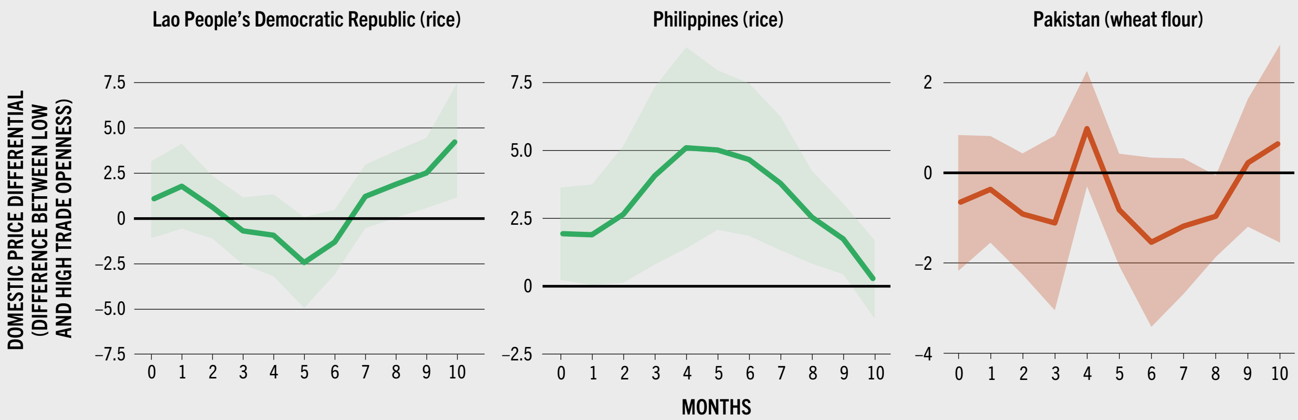
will mirror a scenario in which no trade policies were enacted to shield their markets from the initial shock.[39]

The research undertaken for this report also provides an in-depth analysis to capture the velocity and magnitude of shock propagation, depending on the extent domestic economies are open to trade or not during the 2005–2024 period.[i] As compared to the analysis presented in Figures 4.4 to 4.6, decomposing trade openness regimes provides deeper insights into how shocks can propagate during periods of substantially low trade openness that often identify significant global disruptions. Figure 4.9 illustrates the propagation paths of world price shocks in the Lao People's Democratic Republic and the Philippines rice markets and the wheat market of Pakistan – countries that implement policies to stabilize domestic prices, either through public stockholding or trade measures. In the Lao People's Democratic Republic, low trade openness results in a delayed but relatively strong amplification of the shock in the domestic rice market. This may be due to the possibility of a multiplier effect of policies that amplifies the shock's impact on world prices, thus resulting in price increases passing-through into the domestic economy.

Periods of low trade openness in Pakistan result in a weak and temporary amplification of the shock's impact on the price of flour, potentially

i The analysis in the previous section provides an average propagation path of the shock in each country under examination over the 2005–2024 period. Additional analysis includes trade openness variables that capture the variation of policies that insulate or expose the economy and shape the propagation of the shock.

FIGURE 4.9 PROPAGATION OF WEATHER SHOCK RESULTING IN A 1 PERCENTAGE POINT INCREASE IN THE WORLD PRICES OF RICE AND WHEAT IN THE MARKETS OF THE LAO PEOPLE'S DEMOCRATIC REPUBLIC, THE PHILIPPINES AND PAKISTAN (DIFFERENCE OF PROPAGATION UNDER LOW AND HIGH TRADE OPENNESS)



NOTES: Response to a one-time weather shock (normalized to a 1 percentage point increase) and domestic price responses in the Lao People's Democratic Republic (rice) and Pakistan (wheat). Shaded areas are 68 percent (dark shade) and 90 percent (light shade) confidence intervals. Positive values indicate stronger transmission when the shock occurs during low trade openness, negative values indicate attenuation relative to high trade openness periods.

SOURCE: Lucidi, F.S. (forthcoming). *Local food prices and the international price disruption – Background paper for The State of Agricultural Commodity Markets 2026*. Rome, FAO.

due to policies that stabilize the wheat retail market. In the Philippines – one of the largest rice importers – substantial low trade openness results in a persistent amplification of the shock, reflecting the role of imports in replenishing the country's buffer stock. Indeed, the Philippines imported aggressively in early 2008 to build rice stocks and mitigate the effect of the surge in world rice prices. Nevertheless, strengthening import demand for rice significantly during this period, in conjunction with export restrictions by major rice exporters, contributed to the world rice price surge.[40]

A simulation study on what would be the potential effect of export restrictions on the prices of world cereals during the COVID-19 pandemic best illustrates the impact of non-cooperative behaviour.[41] While the initial shock of the pandemic – a result of disruptions in the supply chains of 50 countries most affected by COVID-19 – would reduce cereal exports and bring about an increase of 4.9 percent in their world price, the imposition of export restrictions to stabilize domestic markets would increase the impact of the initial shock twofold, amounting to 9.9 percent. With countries adjusting their trade policies to maintain domestic stability, the decline in export supply in global markets would further amplify this impact, leading world cereal prices to increase by 16.1 percent relative to their level before the pandemic. ■

PUBLIC STOCKHOLDING: BUFFER STOCKS, FOOD DISTRIBUTION STOCKS AND EMERGENCY FOOD RESERVES

Food stocks form an integral component of resilience strategies. When aggregate food stocks decline to minimal levels globally, world prices become highly sensitive to shocks, as in the 2007–2008 food price crisis (see **Part 1**). In a cooperative simulation scenario in **Part 2**, the use of food stocks mitigated the effects of shocks both in domestic and global markets. Accumulating inventories by buying when prices are low and selling when they are high, traders reduce their risk, and smooth supplies and prices. However, private storage may not prevent extreme price spikes originating from systemic shocks. Private actors rarely hold stocks sufficient to address major and prolonged disruptions and, in many countries, governments ensure the public provision of cereal stocks to safeguard food security.

Countries tend to deploy one or more of three types of public food stocks. Food distribution stocks are integrated with social protection mechanisms, targeting poor households through in-kind relief or retail outlets providing food at subsidized prices. Emergency food reserves focus on markets, with releases aiming to increase food availability and smooth food price shocks in the short term. These reserves are constrained to a level equivalent to one or more months of national consumption and do not seek to stabilize prices or farm incomes. Buffer stocks, in contrast, aim to stabilize prices and target both consumers and producers. Governments typically establish a price band – where a floor price aims to support farmers and the ceiling price protects consumers from price hikes – while food procurement and releases from the stock keep prices within the band.[42,43]

In practice, the line between these different types of stocks can be ambiguous. Often, countries implement public stockholding programmes that aim to fulfil several objectives simultaneously, such as providing incentives to producers, maintaining affordable prices for consumers, addressing food emergencies and supporting the poor.

Buffer stocks are politically sensitive. As they involve predetermined floor and ceiling prices, they operate in conjunction with trade policies that insulate domestic markets, thus distorting world prices. In addition, their implementation is challenging in terms of the high costs they incur. In general, since the 1990s, the use of such policies has declined due to their high budgetary costs and economic reforms, including the trade liberalization of food and agricultural markets.[44]

Nevertheless, in response to global food price shocks, many countries, such as China, India, Indonesia, Pakistan, the Philippines and Zambia, expanded their buffer stocks. In India, the Food Corporation of India maintains public stocks for rice and wheat, procuring from farmers at minimum support prices and releasing them through the Targeted Public Distribution System at subsidized prices to low-income population groups. From 2019 to 2024, India procured the equivalent of 30 percent of domestic production, with the cost amounting to USD 35 billion in 2022–2023, representing about 1 percent of GDP.[45] A study estimated that in India, Indonesia, the Philippines and Zambia, the costs of operating buffer stock programmes varied between 0.5 percent to 1.5 percent of the GDP.[46]

In Pakistan, the Pakistan Agricultural Storage and Services Corporation procures wheat at minimum support prices and releases to millers at subsidized prices, setting ceilings on the retail price of flour.[47] These operations – financed by commercial loans – placed a substantial financial burden on the country. In 2013–14, the annual fiscal cost was estimated at USD 280 million, in addition to USD 900 million of the unpaid liabilities accumulated from previous years.[48] In 2025, the federal government ceased setting a minimum support price for wheat and suspended procurement, following the decision of Punjab – the largest agricultural state – not to procure wheat above market prices in 2024.[49]

In the Philippines, the multiple policy goals of the National Food Agency (NFA), such as stabilizing prices, supporting self-sufficiency and controlling imports through quantitative restrictions, have resulted in high costs, contributing to budget deficit and public debt, leading to policy reforms. Since 2019, quantitative restrictions on imports have been replaced by import tariffs, while the NFA, which had a monopoly over rice imports, sources its stock through purchases from farmers only, crowding-in the private sector.[50] Tariff revenues are now used to fund programmes to improve productivity, while the NFA's objective shifted from price stabilization to emergency response, reducing its stock from 1.8 million tonnes in 2019 to 127 000 tonnes in 2023. Even within this narrow mandate, the NFA continues relying on fiscal outlays to continue its operations. By 2023, the negative government net equity in the NFA balance sheet reached PHP 116 billion, or USD 2 billion.[51]

Uzbekistan, a double landlocked country importing wheat from Kazakhstan only, faces inconsistent import flows due to export restrictions. The country reformed its buffer stock programme, which, historically, procured an equivalent to 50 percent of domestic wheat production – and released the grain at subsidized prices to state flour mills. In 2024, the government procured the equivalent of 11 percent of annual food wheat consumption to crowd-in the private sector and complement private stocks. At the same time, social protection programmes provide cash transfers to low-income households, further reducing the costs associated with the stock's operations.[52]

As global food markets become increasingly under pressure by geopolitical tensions, conflicts and weather extremes, public food stockholding programmes can contribute to strengthening food-importing countries' resilience. The compound effect of geopolitical tensions, conflicts and weather extremes, have led some high-income food-importing countries to maintain public food stocks. For example, Switzerland maintains emergency reserves equivalent to four months of the national consumption of cereals. In 2024, Norway – a country that had previously stored grains in the 1950s – established an emergency reserve of 15 000 tonnes of grain. As in Switzerland, these reserves are maintained through subsidies to the private sector to invest in additional facilities, store food and release it at market prices in case of emergencies.[53] Analysis suggests that storage subsidies to the private sector could achieve gains in terms of price stability similar to buffer stocks without distorting prices.[54]

Reforming buffer stocks to address challenges presented by multiple shocks will be important, given their world price-distorting effects and the unsustainable budget costs that arise from the frequency and size of disruptions. Discussions could focus on evaluating alternative policy options, such as, for instance, maintaining emergency food reserves through subsidized private storage or relatively small food distribution stocks, integrating them with social protection safety nets targeting low-income population groups. For example, during the 2007–2008 global food price crisis, safety nets – relying on both cash and in-kind assistance – were effective in promoting food security and nutrition across countries as, often, the problem was one of access and not of availability.[55]

Evidence indicates that cash transfers can be particularly effective during price surges in protecting the consumption of many essential micronutrients.[56] In 2008, Mexico's Oportunidades – a programme aiming at combating poverty – increased cash transfers to maintain the beneficiaries' purchasing power.[57] Food distribution stocks linked to in-kind food transfers tend to be more effective when price volatility is high. A study indicates that, in the context of high food prices in Ethiopia in 2006–2008, food transfers or cash plus food packages were superior to cash transfers alone in promoting food security.[58]

Safety nets can serve as effective policy alternatives to price stabilization mechanisms and trade policies. As they target vulnerable population groups, they do not attempt to manipulate domestic food prices, and they do not destabilize global markets. For such initiatives, well-defined, clear and transparent triggering mechanisms supported by effective early warning systems and targeting mechanisms increase effectiveness in protecting the vulnerable. A key advantage of safety nets is the ability to be scaled up or down in response to evolving crises or food price fluctuations. To achieve this flexibility, robust administrative systems and dynamic financing mechanisms are required. Targeting within safety net programmes should also be dynamic to reflect the changing food security situation caused by shocks. Such shocks can worsen the circumstances of already poor and food insecure people but may also push net-food buyers, who were not previously poor, into poverty. Therefore, eligibility criteria must be responsive to these changes, ensuring that assistance reaches newly affected groups as needed. Digital technology can help reduce the costs of targeting, as for example, India's One Nation One Ration Card programme that enables beneficiaries to access subsidized food, based on biometric identification.[59]

International buffer stocks

The debate over international buffer stocks gains prominence whenever global food prices spike. This debate traces back to the Bretton Woods negotiations in 1944, where leading economists, notably John Maynard Keynes, advocated for the establishment of international buffer stocks for commodities. However, these proposals aimed at creating a global monetary and trade governance system, stabilizing prices, exchange rates and addressing imbalances between trade surplus and deficit countries.[60]

The International Commodity Agreements (ICAs), led by the United Nations Conference on Trade and Development (UNCTAD), were designed to stabilize prices through buffer stocks (for cocoa, rubber and tin) or export controls (for coffee and sugar). All ICAs have collapsed or been replaced by agreements of which the main role is market information provision, illustrating the challenges of stabilizing prices globally.

International buffer stocks mechanisms are generally regarded as ineffective. The costs of operating buffer stocks at a global level to stabilize world prices are significant, much higher than those incurred by national buffer stockholding programmes. Studies indicate that these high costs are determined by the dynamics of food commodity prices, where violent spikes are more likely than downward ones. As a result, substantial stocks will have to be maintained for long periods to defend against price surges, where it will be inevitable that the stock will be exhausted.[61,62] In fact, such high costs contributed to the collapse of ICAs concerning coffee and tin.[63]

Regional food emergency reserves initiatives

Regional initiatives, such as the ASEAN-Plus-Three Emergency Rice Reserve (APTERR), the South Asian Association for Regional Cooperation (SAARC) Food Bank and the ECOWAS Food Security Reserve, aim to increase efficiency by pooling resources from countries in the region and save costs through economies of scale. Indeed, analysis by the World Food Programme suggests that the required size of the ECOWAS Food Security Reserve would have to be 35 percent smaller than the combined national stocks.[64]

Nevertheless, these initiatives face operational challenges and limited cooperation. For example, APTERR's effectiveness is hampered by a lack of clear definitions on what constitutes an emergency and slow consensus decision-making. Since its establishment in 1988, the SAARC Food Bank has been used only once, in 2020, due to procedural complexities. The ECOWAS Food Security Reserve is part of a broader food security framework in Western Africa that includes safety nets, early warning systems, market monitoring and crisis response plans. As of 2023, the Reserve had intervened on 14 occasions across five countries, however persistent funding shortages and unmet stock targets continue to limit its overall impact.[65]

Enhanced regional coordination among participating countries, comprehensive operational guidelines and well-defined rules, and increased financial resources can significantly improve the efficiency and impact of regional food emergency reserves. ■

NOTES

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THE STATE OF THE WORLD

2026 THE STATE OF AGRICULTURAL COMMODITY MARKETS

TRADE, RESILIENCE AND FOOD SECURITY GLOBAL FOOD MARKETS UNDER STRESS

Food and agricultural trade increased fivefold between 2000 and 2024, with low- and middle-income countries becoming more integrated into global markets. Yet these markets face growing exposure to shocks, including extreme weather, conflicts, pandemics, macroeconomic pressures and financial crises. The 2026 edition of *The State of Agricultural Commodity Markets* examines how such shocks affect trade, how disruptions are transmitted through trade linkages and what this means for global food security. It highlights the need for trade policies that reflect the interdependence of agrifood systems, strengthen resilience and help mitigate the effects of shocks on food markets and food security.

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