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# Food accessibility and security: An investment intangible

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## Foreword

A combination of factors largely centered around fears of recession coupled with fears of persistently higher inflation influenced volatility across capital markets in 2022. The drivers of these fears did not appear overnight and solving these issues will require comprehensive approaches from governments, corporations and individuals. As investors, we can view this through the lens of the global food supply chain.

Before the current war in Ukraine, close to 193 million people globally experienced acute food insecurity, defined as a household-level economic and social condition of limited or uncertain access to adequate food.[1] The Russia-Ukraine war and the COVID-19 pandemic exacerbated the debilitating global issue of food insecurity, often disproportionally affecting women, children, the working poor, elderly and people with illness. However, as climate change intensifies, driving droughts, flooding and wildfires, more people may experience food insecurity.

Addressing economic stability, equity, and raising people out of poverty remains crucial to reducing food insecurity. As asset managers and investors, we see our role as playing a critical part in addressing economic stability, fostering inclusion and providing equity. Beyond its human devastation, food insecurity directly impacts many aspects of our global economy. In this paper, we look at the influences of food security goals through the lens of an active investment manager.

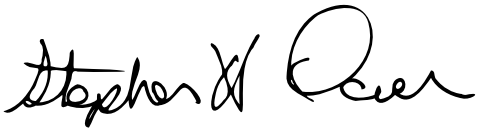
- **The escalating concerns over climate change threatens food production quantity and nutrition.** Fighting these threats requires financial resources, both in mitigation efforts and in adaptation. A country's food production capacity could create a competitive advantage, while water stress could potentially limit progress.
- **We think private markets will increase future investments in food innovation.** Though public market investments remain critical, venture capitalists invested over US$45.6 billion in food-tech startups across 3,200 separate deals from 2015–2019.[2] Vertical farming is still in the nascent stage of development and yet, investment in this technology is mostly through venture capital.
- **The global population is expected to increase, and so will food costs.** Financing for agricultural development and climate change could increase for mitigation and adaptation. Countries with high debt may experience disadvantageous economic

positions, especially if interest payments as a percentage of their reserves and revenues increases. Credit risk premiums would also be impacted as sovereign financials could deteriorate. Ratings agencies seem more responsive to changing dynamics in their ratings assessments since the 2008 global financial crisis. Government support, international institutions, banks, multinational and private companies—along with investors—can play a huge role in increasing food security globally. Optimizing funding networks remains critical.

- **Some countries are experiencing substantial increases in their older, non-working populations.** Diminished food production and nutrition could deteriorate health conditions, decreasing productivity further.

Financial markets will play an increasingly important role in addressing food-related challenges, including the need to improve food security and develop more research and agricultural technologies. The long-run assessment of geopolitical risks with Franklin Templeton Institute's Country Risk Framework is complemented by the short-run monitoring tool deploying several observable indicators. In tandem, we think this provides a more comprehensive guide for investors.

We hope this piece will help you understand the issues stemming from food security and the impact financial markets can play in addressing potential solutions.



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# Executive summary

Over the last decade, we have witnessed a growing pattern of geopolitical rivalry driving policies that are inconsistent with orthodox economic logic. As a result, investors needed to consider a wider range of risks to their investment cases. In this report, we address food security issues through an investment lens, and assess the corresponding clear, present and future threats and opportunities to investment outcomes.

## Causal relationship between some food insecurity and political instability

In 2021, hunger affected as many as 828 million people across the globe. According to a United Nations report, there is fresh evidence that the world is moving further away from its goal of ending hunger, food insecurity and malnutrition in all forms by 2030.[3]

Climate change, the COVID-19 pandemic and the 2022 war in Ukraine have contributed to surging prices, impacting the affordability and drastic reduction of availability of basic foodstuffs. Non-working and the working poor in countries that depend on food imports, especially for staple foods, are the most affected. Food prices have started on an upward trend since 2016, and prevailing food security issues escalated further since the COVID-19 pandemic.[4]

There is research to suggest a causal relationship between food insecurity and political instability exists, specifically in the comparative analysis of three "Arab Spring" cases—Egypt, Syria, and Morocco—using the Process-Tracing Method. While this research does not imply that food insecurity triggered all Arab Springs, it assumes that rising food prices increased the pre-existing social unrest, sparking protests in Egypt, Syria and Morocco, and probably also in other MENA countries the riots affected.[5] In Peru, the war in Ukraine exacerbated food and fuel inflation and led to protests that threatened to destabilize the government.[6] While there are additional examples from the past, we believe the opportunity for future unrest is probable as global food prices have hit a 10-year high.

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## How do we assess food security?

Franklin Templeton Institute developed a proprietary Country Risk Framework to help us identify countries that may be at higher risk for instability. Within the framework, we combine four factors to determine a Food Security Score: undernourishment, poverty, staple food imports and food insecurity.[7] Exhibit 1 on the next page, highlights the countries that are currently in a weaker position with lower scores, and those that are in a better position with higher scores.

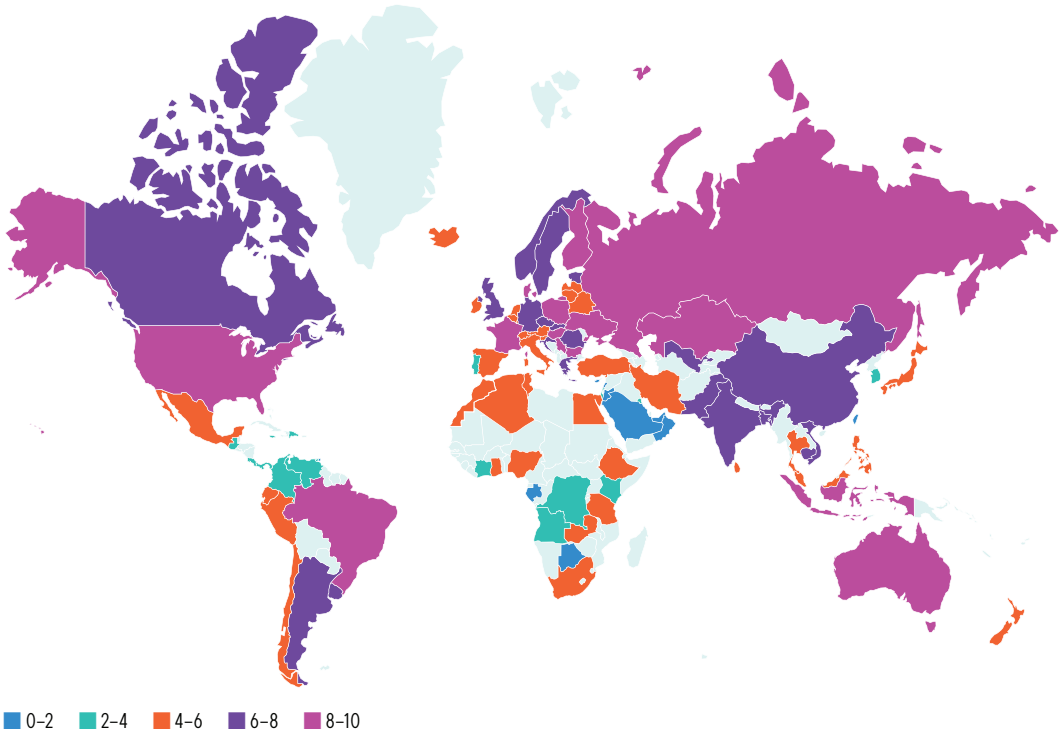
A widening inequality gap, global population growth and rising concerns over climate change may keep the pressure on social issues. For investors, the country risk premiums could change in either direction with respect to political stability or creditworthiness, depending on government actions.

## Public policies to aid in addressing food insecurity

Over the past few decades, agricultural technology and government support have endorsed solutions for improving agricultural yields while addressing the issues of poverty, hunger, deforestation[8] and climate change. However, modern technology by itself cannot increase food security. Government support and public involvement can expedite development and adoption. Other factors include the cost of capital and labor, a country's exposure to agriculture, the skill level of those employed, and the available infrastructure.

## Food Security Depends on the Intake of Food, the Population Below the Poverty Line and the Import Dependency for Staple Foods

**Exhibit 1: Food Security Score**
As of November 2022




Sources: United Nations Department of Economic and Social Affairs, World Bank, Macrobond. Analysis by Franklin Templeton Institute.

Notes: Scores range from 0 to 10 with 0=worst situation, 10=best situation. Scores are based on latest data for: (1) undernourishment data from World Bank; (2) poverty data from World Bank; (3) staple food (wheat, rice, corn barley for all countries and soybeans as well for Argentina, Brazil, China and the United States) imports as a percentage of domestic supply, calculations based on data from FAO; (4) food insecurity data from United Nations Department of Economic & Social Affairs. Scores are as of November 2022, based on latest data available across the 100 countries covered in our Country Risk Framework. Important data provider notices and terms available at www.franklintempletondatasources.com.

While there has been success for some countries in the adoption of agricultural technology, the capital investment and specific research required have hampered others. Additionally, the agricultural sector may need government support to bear the cost of adopting modern technology, and timelines are long. Governments require channels to provide financial support, with financial institutions key facilitators.

As a proxy for technology adoption, we look at the unbanked population—those without access to a bank accounts. Emerging countries have a greater unbanked population. As per World Bank, 1.4 billion adults globally do not have a bank account.[9] Of these 1.4 billion adults, more than half reside in India, China, Pakistan, Indonesia, Nigeria, Bangladesh and Egypt.[10] There is a high correlation between global statistics on the unbanked and poverty. For one, 75% of all unbanked people are poor.[11] At the same time, these countries have a high percentage of the population dependent on agriculture (especially India, Bangladesh, Nigeria and Pakistan), indicating lower capacity to adopt technology amid rising climate change risks.

It is not only the government's role to support and facilitate its economy that matters, but also its executive role in the implementation of agricultural reforms. Sovereign financials and governance ties with staple food producers underpin the government's role to drive reforms. This fosters the use of public resources to transform food systems, not only making them more efficient, but also more supportive of the United Nations Sustainability Development Goals.[12] From a portfolio management perspective, all must work together to increase food security to reduce risk premiums for future investment horizons.

The world's population will likely keep growing. This expected population surge, combined with the negative impacts of climate change and the likelihood of disrupted harvests in the future, have made increasing food security a top priority. There is an urgent need to accelerate innovation, increase food production sustainably, improve food processing models, eliminate waste and enhance nutritional values.

Food innovation in terms of production, storage and distribution need development—countries which import foods may strive to diversify their sources at a country-level, and also seek to improve their logistics. A lot of tech development takes place with the involvement of private companies, potentially providing attractive investment opportunities. Investors can help finance such initiatives through investments in growing industries that would also address their sustainability investment goals.

# A framework for investing in food accessibility and production

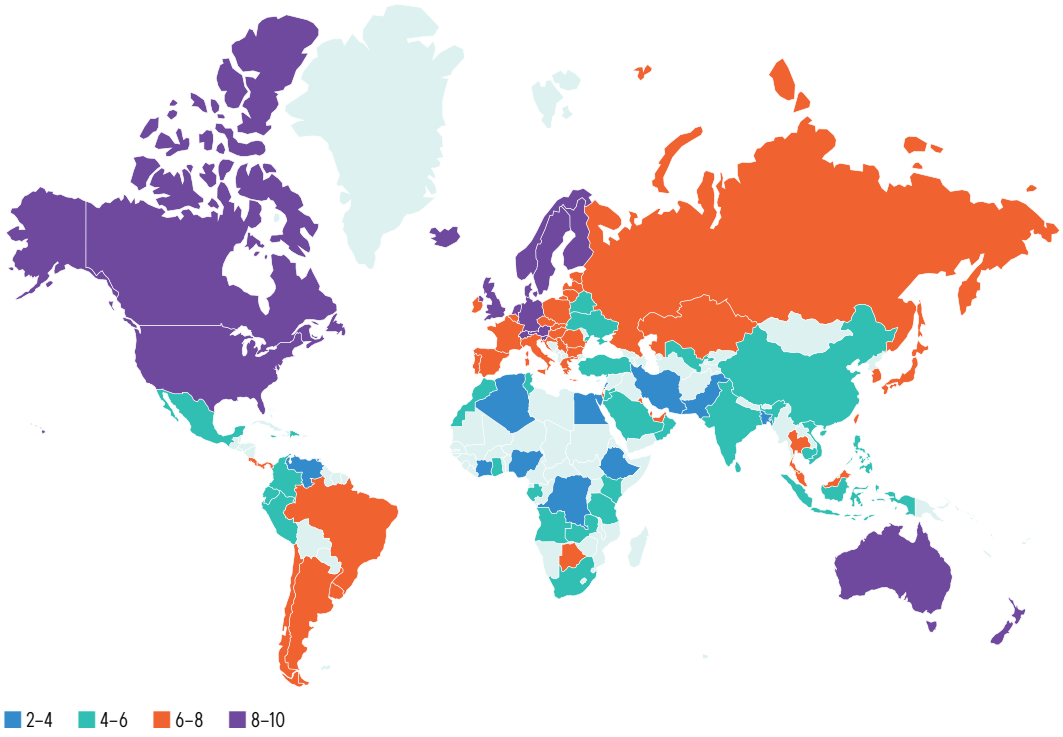
A country's long-term risks have multiple dimensions and factors that affect investment portfolios. Franklin Templeton Institute's Country Risk Framework uses a proprietary model to evaluate and score every country's preparedness for future challenges assessed across these six categories: demographics, digitization, environmental, social and governance (ESG), geopolitics, government regulatory and sovereign financials.

Based on Franklin Templeton Institute's Country Risk Framework, we use our investment lenses to first research a country's position, including political stability, ability to address food insecurity, investment in education and ability to pragmatically address its structural and climate change weaknesses. We then deepen our analysis by investigating the links between food and water before assessing public health, a country's vulnerability to climate change, and the role of governments.

We calculate scores that range from zero to 10 to measure these risks across 100 countries, with zero as the least prepared and most at risk. We assess most of these issues and factors using third-party indexes and data, lending itself to sound long-term analysis. While most of the country scores are a snapshot of their current situation,[13] they provide investment insights for a country's structural weaknesses unless policymakers and other stakeholders address them.

## Social Cohesion Based on Politics, Basic Needs and Climate Change

**Exhibit 2: Social Cohesion Scores**
As of November 2022




Sources: IMF, World Bank, FAO AQUASTAT, GHS Index, and Notre Dame Global Adaptation Initiative, Macrobond. Analysis by Franklin Templeton Institute.

Scores range from 0 to 10 with 0=worst situation, 10=best situation. Scores are based the latest data available for on Dependence on Food (food weight in inflation basket, food imports as a percentage of total import, staple food imports as a percentage of its domestic supply, and agricultural raw materials imports), Water Stress (annual water withdrawal and access to safe drinking water), Global Health Security Index, Notre Dame's Climate Change Vulnerability Index, Political Stability and Absence of Violence/Terrorism and Regulatory Quality sourced from IMF, World Bank, FAO AQUASTAT, GHS Index, and Notre Dame Global Adaptation Initiative, and World Bank. Scores are as of November 2022, based on latest data available across the 100 countries covered in our Country Risk Framework. Important data provider notices and terms available at www.franklintempletondatasources.com.

To begin with, we measure systems that we believe contribute to stability. Climate change determines and influences food and water availability and reliability. Climate change affects an economy as it inhibits potential economic growth and adversely impacts economic inequality. Exhibit 2 on the previous page, shows the relative stability scores for countries based on these factors.

## Repercussions of climate change

**Climate change adversely affects infrastructure and logistics. Government finances and private-sector contributions can build crucial climate-resilient infrastructure to protect crop production, avoid food wastage and provide accessibility to necessities.**

Climate change threatens a third of current global food production.[14] The goals of the Paris Agreement would reduce these risks to about 5%–8% of global food production.[15] According to an UN Food and Agriculture Organization (FAO) report published in March 2021, agriculture absorbs a disproportionate share of 63% of the losses from natural disasters, with the least-developed countries and low- and middle-income countries most affected. Natural disasters accounted for US$280 billion across different economies between 2008 and 2018. The estimated losses low- and lower-middle-income countries incurred because of declines in crop and livestock production was estimated at US$108.5 billion. Over the same period, Asia was the most hard-hit region, with overall economic losses of US$49 billion; Southeast Asia and Southern Asia surpassed all other sub-regions at US$20.7 and US$25 billion respectively. Economic losses attributed for US$30 billion in Africa, and US$29 billion in Latin America and the Caribbean.[16]

Climate change adversely affects infrastructure and logistics. Government finances and private-sector contributions can build crucial climate-resilient infrastructure to protect crop production, avoid food wastage and provide accessibility to necessities. Access to food, water, energy and healthcare could be particularly important. This could help stabilize food supplies and prices, while helping to channelize constrained public finances towards optimal public health investments.

### Water stress

Half of our world's population experiences extreme water scarcity in any given year. Around 54% of India presently experiences "high to extremely high" water stress.[17] In the Middle East available irrigation water projections suggest declines by 13% to 28% by 2050, depending on the climate model output and scenario.[18] For North Africa, the projected decrease is 9% to 25%.[19] And in the United States, two of the largest reservoirs may reach dangerous "dead pool status."[20]

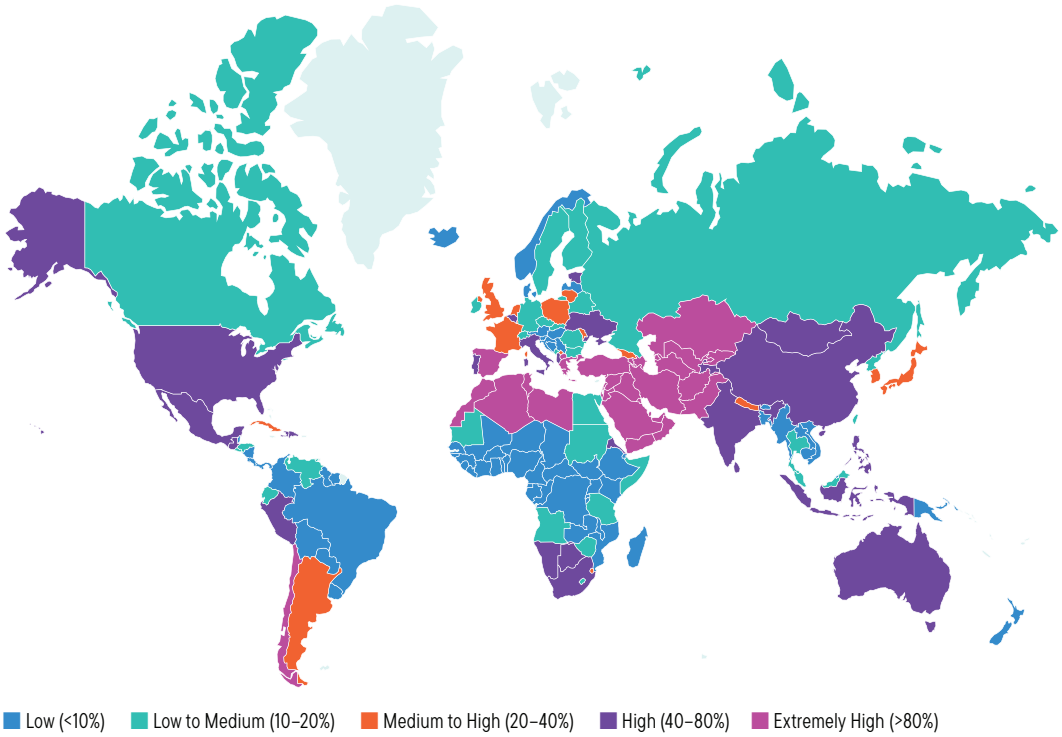
Overexploitation of water resources with shrinking reservoirs affects droughts. The American Geophysical Union predicts more than 80% of croplands globally by 2050 will suffer.[21,22] The demand for water worldwide accelerated twice as fast as the human population in the last 100 years.[23] Consequently, water stress is expected to increase over the next couple of decades (see Exhibit 3 on the next page).

As climate change intensifies, agricultural soil and water sources will deplete further. Crop production uncertainty could aggravate food exporters' tendencies to withhold higher supplies for domestic consumption, impacting food-importing countries. Higher expenditures on food and higher water stress could further aggravate this tendency among food exporters, making the countries with high food imports and consumption even more vulnerable (see Exhibit 4 on the next page). In Brazil, China and India, a large proportion of cropland in tropical areas experiences high water stress. These countries rank among the largest producers of staple crops. China and India rank among the world's largest wheat producers.[24] India has raised concerns over climatic conditions for its wheat supply production, to the extent that it banned wheat exports to manage its country's food security.

## High Water-Stress Expectations

**Exhibit 3: Water Stress by 2040: Total Annual Water Withdrawals as a Percentage of the Total Annual Available Blue Water**

Estimates are as of August 2015




There is no assurance that any estimate, forecast or projection will be realized.

Source: Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 2015. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

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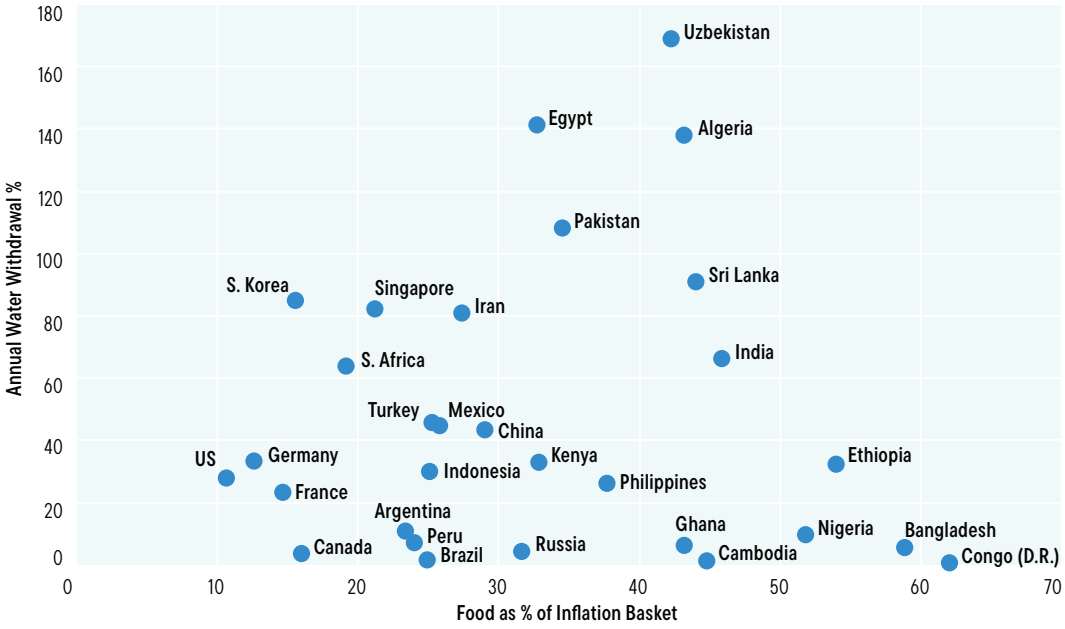
## Higher Dependence on Food and Increased Water Stress Will Affect Food Security

**Exhibit 4: Food and Water: Select Countries**

As of November 2022




Sources: FAO AQUASTAT, IMF, national sources, Macrobond.

Notes: Annual water withdrawal measures freshwater withdrawal as a percentage of available freshwater resources, after considering environmental water requirements. This measures the level of water stress as per the Sustainable Development Goal 6.4.2. Each dot in the scatter plot represents a country. National sources may include central banks, ministry of finance, or treasuries. Important data provider notices and terms available at www.franklintempletondatasources.com.

Water flooding owing to rising sea levels destroys crops. After droughts, floods are the second-largest disaster for the agricultural sector. Over the period of 2008–2018, floods accounted for about 19% of the total crop and livestock production loss amongst the least-developed countries and lower-to-middle income countries.[25] The most-affected countries were in Africa, Latin America and the Caribbean, and Asia. Of these regions, Asia had the most crop and livestock production loss due to floods, accounting for up to 23% of the total loss.[26] In India and Bangladesh, which share the Sundarbans, each year's flooding has destroyed a quantity of rice equivalent to food for 30 million people.[27]

**Locust-related losses for staple crops, livestock production and asset damages were estimated at US$8.5 billion for countries in the wider East Africa region, Djibouti and Yemen. Considered the most destructive migratory pest in the world, a small swarm of the desert locust covers one square kilometer and can eat the same amount of food in one day as 35,000 people.**

### Pests exacerbates supply shocks

Climate change supports the growth of pests. Higher temperatures create conducive environments for pest hatching and breeding. This could also create new pest species and decrease agricultural production. Any reduction in biodiversity can create a surge in pests, contributing to further decreases in food production.

Up to 40% of food crops perish from pests and diseases each year during normal seasons, according to the UN FAO.[28] Estimated losses could be higher during abnormal seasons and epidemics, such as the 2019–2021 locust outbreak in regions of East Africa, the Arabian Peninsula, the Indian subcontinent and South America. Locust-related losses for staple crops, livestock production and asset damages were estimated at US$8.5 billion for countries in the wider East Africa region, Djibouti and Yemen.[29] Considered the most destructive migratory pest in the world, a small swarm of the desert locust covers one square kilometer and can eat the same amount of food in one day as 35,000 people.[30] The challenge to combat this threat magnifies as new species of pests increase and pests become resistant to pesticides.

Major breadbaskets of North America, Europe and other countries in temperate areas may experience huge crop losses where global warming will increase both pest population growth and metabolic rates.

Staple foods of wheat, corn and rice feed about four billion people, and account for about 42% of direct calories humans worldwide consume per year, according to the UN FAO. Any adverse impact in crop production due to climate change could lead to a sudden rise in trade protectionism in countries that export staple foods. Before the COVID-19 pandemic, the Intergovernmental Panel on Climate Change's (IPCC's) global crop and economic models projected a median increase of 7.6% (range of 1% to 23%) in cereal prices in 2050 due to climate change.[31] The decreased quantity of crops due to pests and increased prices can lead to devastation for countries with people experiencing food insecurity, more poverty, lower incomes and higher inflation.

Many countries experienced heightened risks for export bans and trade barriers by food exporting countries over the years. A recent International Food Policy Research Institute study noted that the share of calories trade restrictions impact now represents 17% of global consumption.[32]

### Nourishment for our world

By 2050, the world will need to produce 70% more food to feed the projected global population of 9.3 billion, according to estimates compiled by the UN FAO.[33] Taking into consideration that the UN FAO uses 2012 as the baseline we estimate, about 35% more food will still be needed by 2050 to meet the population requirements. Additionally, livestock account for 80% of agricultural land but only 18% of the global calorie supply, requiring higher food production due to increased resource waste. The proportion of our population living below

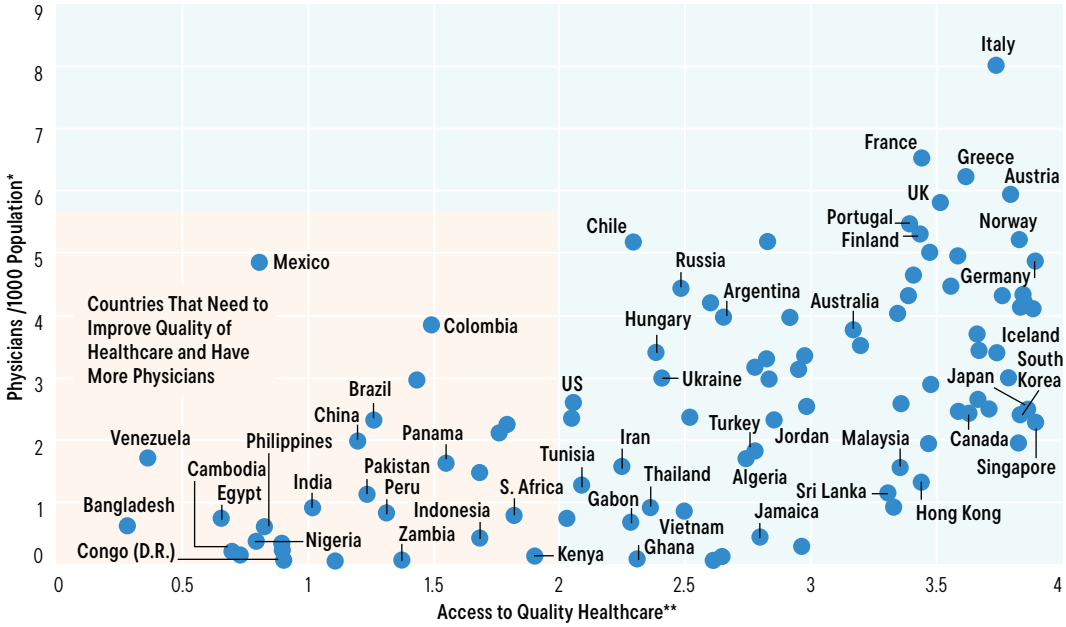
the poverty line automatically increases with higher food prices, in turn increasing the number of people living with food insecurity and undernourishment, especially in low-income countries where food accounts for a large proportion of consumer spending.

Climate change affects not just the quantity of crop output, but also its nutritional value. Rice and wheat could have reduced levels of zinc, protein and iron. In India, zinc and iron levels in rice and wheat has declined over the last 50 years, according to a 2021 research report.[34] By 2050, India could have 49.6 million new zinc-deficient people due to climate change, according to Columbia University research. In addition, 38.2 million people may experience new protein deficiencies, while 106.1 million children and 396 million women may experience iron deficiency, potentially adversely affecting the health and financial welfare of future generations. Exhibit 5 shows how countries are currently positioned with respect to healthcare and the access to quality healthcare and doctors.[35] Agricultural development and healthcare may require more government expenditures, increasing fiscal burdens.

## With Expectations of Higher Food Insecurity, Healthcare Becomes More Important

**Exhibit 5: Quality Healthcare and More Physicians Would be Required to Improve Health Security**

As of November 2022




Sources: Social Progress Imperative, World Bank, Macrobond.

Each dot in the scatter plot represents a country. Important data provider notices and terms available at www.franklintempletondatasources.com.

*As of 2018–2019 or Latest Data Available, World Bank. **As of 2022, Social Progress Imperative (Ranges from 0=Unequal Access to 4=Equal Access).

## Role of public-private partnership

Investors hear consistently that the need for government reforms remains urgent and important, yet in practice, many shades of gray exist. Many food-producing countries offer semi-permanent agricultural sector support, but not all measures offer desirable results for sustainability and human health. Pragmatically deployed, a wide variety of policy initiatives have demonstrated optimized usage of scarce public resources, transforming food systems in ways that make them not only more efficient, but also more supportive of UN Sustainable Development Goals (see “Brazil: Network of support drive productivity” in the Case Study section).

Greater collaboration and cooperation across government, research institutions, non-governmental organizations and the private sector can develop the evidence to build successful repurposing strategies. Just as the private sector needs the support of the government (through financing, reforms and building networks) the government needs

the private sector for its resources (land, labor and skills) and innovation. Our Country Risk Framework analysis reveals the vulnerable countries to include (but not limited to) The Democratic Republic of the Congo, Iran, Nigeria, Pakistan, Ethiopia, Turkey, Bangladesh, Egypt, Kenya, Philippines, India, Indonesia, Thailand, Vietnam, Sri Lanka, Peru and Rwanda.[36]

While we all recognize food's position at the base of Maslow's hierarchy of needs,[37] I believe many countries became complacent after years of globalization and low commodity prices with benign food inflation.

Suddenly, a confluence of factors has put food (and energy) back on the front page for many of the wrong reasons. The 21st century inherited a food security system designed for the 20th century. This is contributing to massive social and health issues. In most parts of the world, today's farms and supply systems would be familiar to those born a generation or two ago. Such historical underinvestment in supply chains, a focus on lowest-cost solutions without factoring in full environmental costs, increasing bargaining power imbalances, and over-usage of agrochemicals are a few of the key culprits. Geopolitics and conflicts add fuel to the fire.

We will continue to invest in answers because humanity depends on it. However, the key is ensuring a transition which benefits all.

This constitutes an enormous challenge for both operators and investors. The opportunity lies in innovation and private sector capital unpinned by government policy supportive to innovation.

**Patrick Vizzone**
*Managing Director, Head of Agri-Food*
Franklin Templeton Asia-Pacific Alternatives

## Short-term investment assessment for food security

Dealing with the long-term underlying challenges requires an assessment of the short-term factors that considers investors, business, consumers and societal factors, apart from finances and executive capacity. Hence, we also consider the factors in our risk premiums through several easily quantifiable lenses, namely market volatility, producer price index (PPI) changes, shifts in food weightings in the consumer basket, and sovereign debt trends. These indicators provide the short-term lens for monitoring geopolitical temperatures and complement the long-term Country Risk Framework.

### Monitoring volatility for stress detection

**As the rising uncertainty of the Russian-Ukraine war increases economic volatility, the US Volatility Index (VIX) and the Economic Policy Uncertainty (EPU) index rose, though less than the early stage of the COVID-19 pandemic in March 2020.**

As the rising uncertainty of the Russian-Ukraine war increases economic volatility, the US Volatility Index (VIX) and the Economic Policy Uncertainty (EPU) index rose, though less than the early stage of the COVID-19 pandemic in March 2020. But the MOVE Index[38]—which measures volatility in the fixed income market—rose faster in comparison, due to higher inflation and interest rates, highlighting underlying economic uncertainty (see Exhibit 6 on the next page). Over time, the war may produce extraordinary effects throughout the global economy because of its effects on energy and food sources and prices.

Higher economic volatility can lead to currency and financial crises, especially in emerging countries. The government spending for short-term challenges would weigh on the funding for longer-term challenges with more critical allocations towards current government spending versus future capital spending.

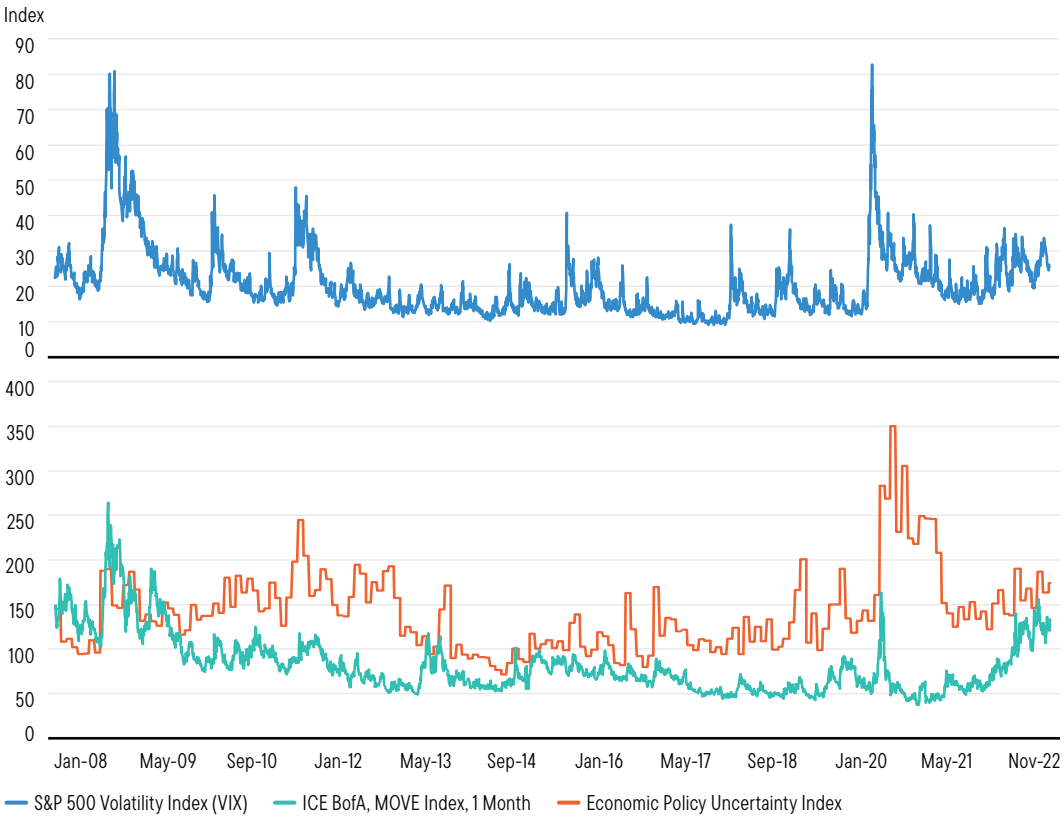
### Warning signals from inflation

The longer inflationary pressure persists, the higher the risk of political instability. The recent rapid rise of producer prices, especially for energy, opened an unusually large gap between producer price and consumer price inflation (see Exhibit 7 on the next page).

## Higher Economic and Market Volatility

**Exhibit 6: United States: Volatility Indices**

As of November 9, 2022




Sources: CBOE, ICE BofA, Economic Policy Uncertainty, Macrobond.

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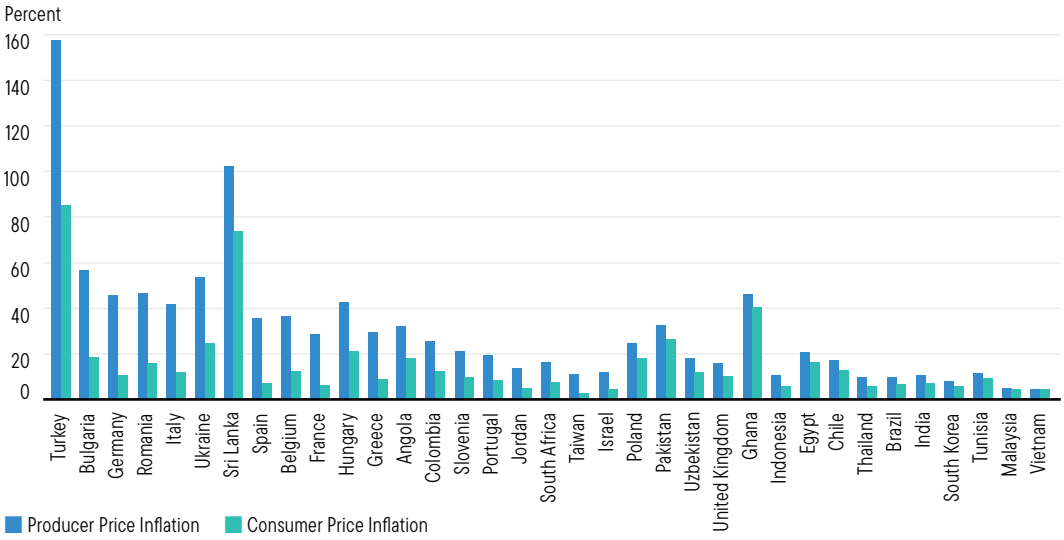
## Producer Prices Have Risen More Sharply than Consumer Prices

**Exhibit 7: Producer and Consumer Price Inflation**

As of November 10, 2022




Sources: National sources, Macrobond.

Notes: Selected countries have high difference between producer and consumer price inflation and experience political instability (a reading of less than 0.8 in the World Bank's "Political Stability and Absence of Violence/Terrorism: Estimate"), high food weight in the consumer price inflation, or high government debt (as a percentage of GDP). National sources may include central banks, ministry of finance, or treasuries. Important data provider notices and terms available at www.franklintempletondatasources.com.

According to a study by OECD,[39] a third of the producers' inflation pressures are passed on to consumers within two months. However, if the producers' inflationary pressures arise due to food or energy prices, then the transfer to consumers occurs more rapidly. Consumers may continue to feel the pinch of higher prices as food and energy prices drive inflation higher.

From a portfolio management perspective, countries with higher food weights in their consumer price index baskets and dependent on imports for energy would experience vulnerability and more risk over the short term. Higher interest rates would also undermine consumers and businesses.

Households would likely reduce their purchases as their budgets shrink. More people would experience poverty, which has already increased due to the COVID-19 pandemic. Government debt would likely stretch, and currency volatility would increase, creating a double whammy for non-domestic investors in these countries.

### Balancing fiscal positions

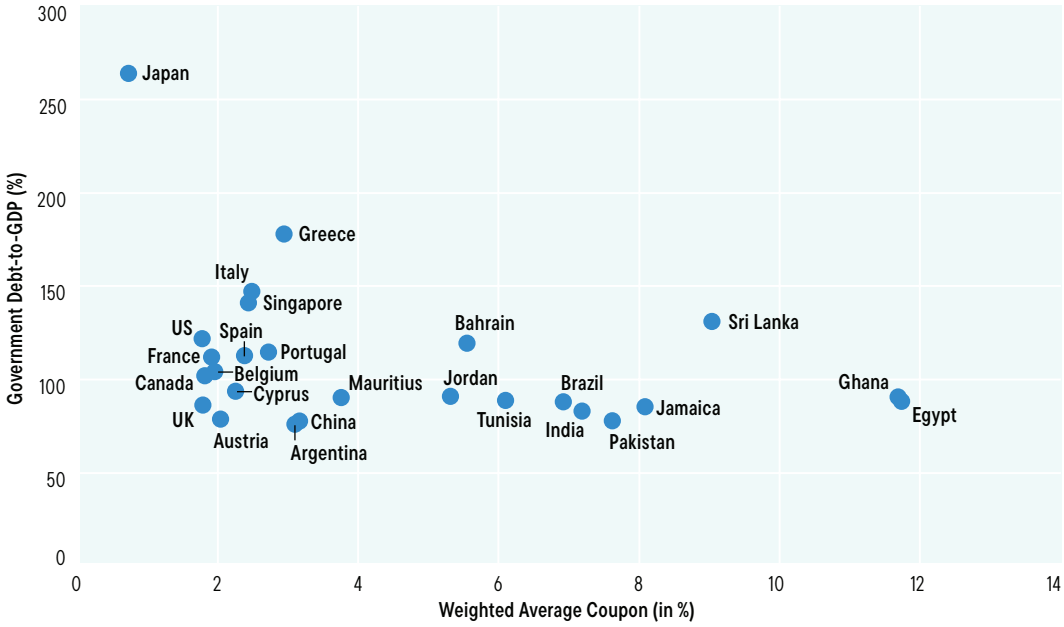
During the COVID-19 pandemic, governments across the world increased their expenditure, increasing their debt-to-gross domestic product (GDP) and possibly shrinking their capacity to undertake further debts. The aim for fiscal consolidation would further squeeze the capacity for expenditure on food, agriculture, education, healthcare and discretionary funding. Political instability increases as a potential impact on countries under pressure to feed their people.

Government measures could take various forms—sometimes, necessary multiple forms—including but not limited to reduced tariffs, affordable loans to farmers, expenditure on research for agricultural technology, price controls and public assistance programs. Logistics and infrastructure for agriculture would provide crucial control to supply side price pressures.

Short-term external debt and sufficient foreign exchange reserves could determine sovereign financial stability. Emerging markets improved their reserve positions over the past few years and reduced their vulnerability as compared to earlier times. However, with climate change gaining pace, countries seemingly lag in terms of readiness. Fiscal consolidation and commitment to continued debt reforms more urgently affect Sri Lanka, Brazil, Jamaica and Egypt.

## Selected Emerging Economies with Debt Close to 100% of GDP and Higher Coupon Rates

**Exhibit 8: Selected Countries with High Debt**
As of November 2022



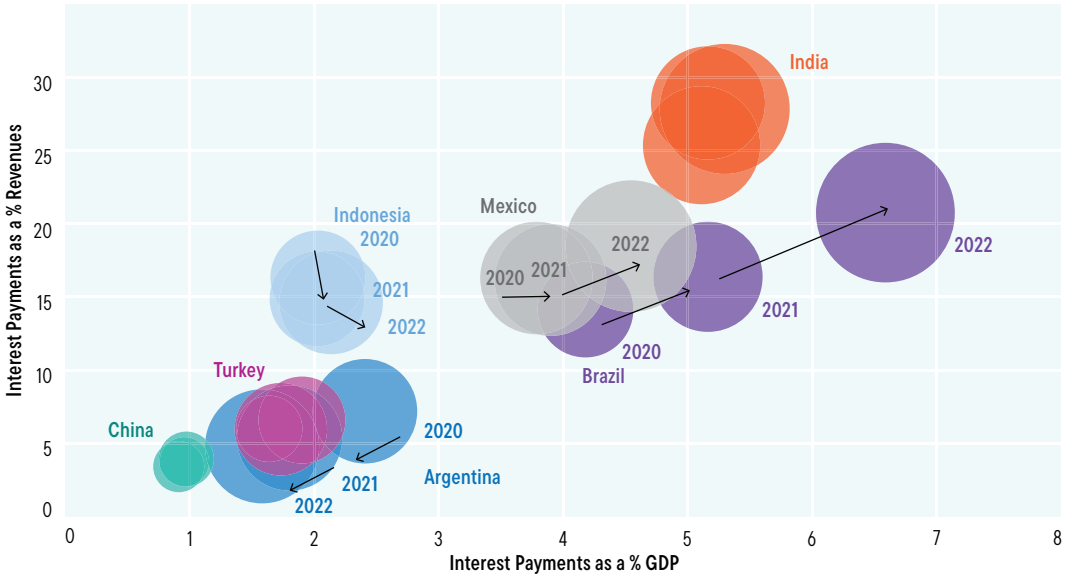

Sources: IMF, Bloomberg, Macrobond.

Government Debt-to-GDP is as of 2022 and Weighted Average Coupon is as of November 2022. From the list of 100 countries that comprise the Country Risk Framework, this chart covers only those with a government debt-to-GDP of more than 75% for year 2022. Important data provider notices and terms available at www.franklintempletondatasources.com.

## Select Emerging Markets Will Have Higher Interest Payments as Compared to Their Money Box

**Exhibit 9: Emerging Markets: Interest Payments as Share of GDP and Revenues**

As of 2022




Sources: IMF, Macrobond. Analysis by Franklin Templeton Institute.

The values are displayed for the years 2020, 2021 and 2022. Bubble size represents interest payments as a percentage of reserves. Important data provider notices and terms available at www.franklintempletondatasources.com.

Higher interest rates would also reduce the capacity for fresh government spending for a given fiscal year (see Exhibit 8 on the previous page and Exhibit 9 above). Countries such as Ghana, Egypt, Sri Lanka, Angola, Jamaica, India and Brazil have higher coupon rates and considerably high government debt-to-GDP ratios. This could result in potentially higher interest payments, consuming a larger portion of the fiscal budget. For instance, as per the IMF's estimates in its World Economic Outlook October 2022, Brazil's interest payments are at 6.59% of GDP, and its fiscal deficit at 5.82% of GDP.[40]

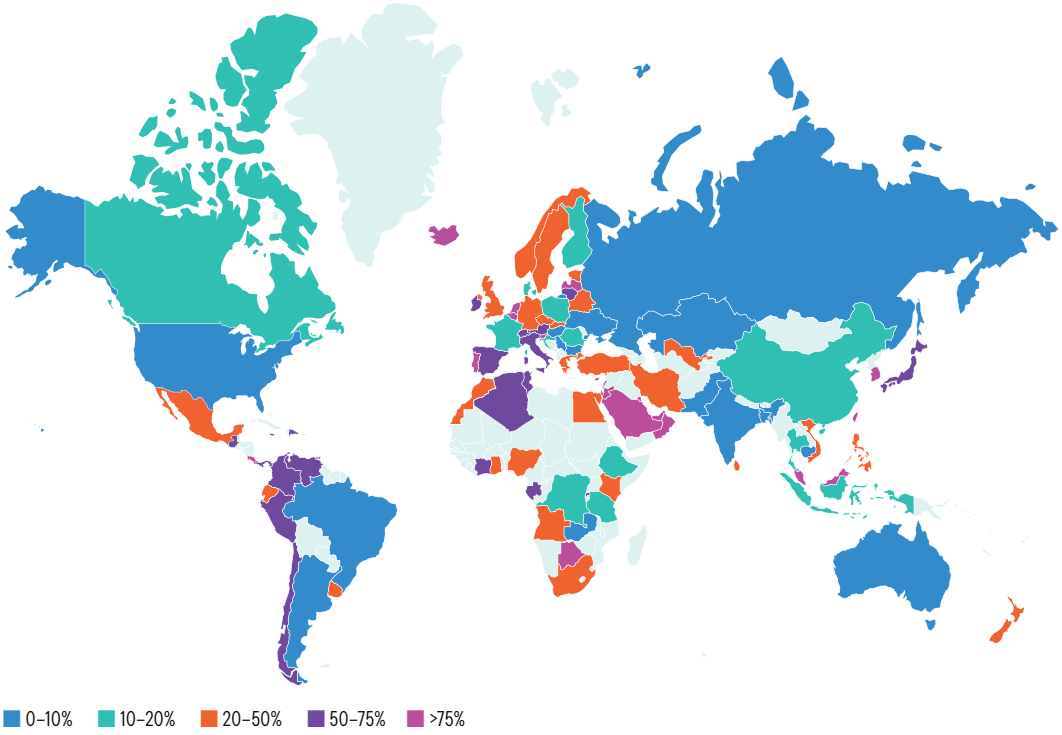
# The investment paths to food security

Food-producing nations have an undeniable advantage, especially those that produce staple foods: wheat, rice, barley, and corn. In contrast, countries highly dependent on food imports as a percentage of their domestic supply—especially for staple foods—experience disadvantages, since they are vulnerable to supply chain disruptions and currency volatility, which contribute to increasing food insecurity (see Exhibit 10 below). For African countries, a 1% depreciation in real effective exchange rates increases the price of highly imported staples by an average of 0.3%, according to a recent IMF study.[41]

## Some African and Latin American Countries Rely Highly on Imports for Their Food Supply

**Exhibit 10: Food Imports as a Percentage of Domestic Supply**

As of 2019




Source: FAO. Analysis by Franklin Templeton Institute.

Notes: Staple foods (wheat, rice, barley and corn) analyzed. Argentina, Brazil, China and the United States include soybeans as a staple food.

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As higher food prices and concerns of climate change can potentially cripple production, food-producing nations can likely restrict export volumes or charge a higher price for exports to provide for their own populations. However, these concerns can be mitigated as multiple stakeholders, including international institutions, government, companies and farmers provide collective solutions.

## Fertilizers refueling the land and prices

The benefits of the use of fertilizers outweigh the costs. A World Economic Forum study shows that US corn yields would have fallen from seven to a little over one tonne per hectare over the last 100 years without the use of fertilizers.[42] Additionally, safe fertilizer usage provides basic nutrients needed for healthy crop growth.

That said, high fertilizer prices could materially impact agricultural crops. Fertilizer prices account for nearly one-fifth of US farm cash costs, with an even greater share for corn (36%) and wheat producers (35%).[43] The International Fertilizer Development Center projects that the lack of affordability and availability of chemical fertilizers could drive down

sub-Saharan African demand by 30% in 2022, possibly reducing food production by 30 million metric tons and affecting the food requirement for 100 million people.[44]

The situation likely will worsen for countries experiencing soil degradation. Countries in Asia and Africa bear the highest costs of land degradation, estimated at US$84 billion and US$65 billion per year, respectively.[45] For instance, China and India tend to have more small farm producers that need financial support and have more domestic production of staple foods. China and India rank amongst the top producers of wheat and corn. Hence, soil degradation exacerbated by climate change creates much worry, juxtaposed with the magnified opportunity costs of not using fertilizers.

A country's vulnerability to soil degradation increases with its dependency on fertilizer imports. South America experiences significant impacts from climate change, increasing its dependency on fertilizers (apart from technological improvements). Brazil and Argentina import about 80%–82% of their fertilizer for agricultural use. India too depends on imports for 40% of its fertilizer usage.

**According to the United Nations Environment Programme's Adaptation Gap Report published in 2021, the estimated costs of adapting to climate change continues to increase and could reach US$280–US$500 billion per year by 2050 for developing countries.**

## Tilling the ground with financial support

The demand for investment and financial support to develop agriculture will more readily coalesce when governments have fiscal surpluses. Expenditures channelized toward specific support measures will likely help achieve the desirable results for food production quantity and nutrition in a sustainable manner.

According to the United Nations Environment Programme's Adaptation Gap Report published in 2021, the estimated costs of adapting to climate change continues to increase and could reach US$280–US$500 billion per year by 2050 for developing countries. This presents a need for governments to increase efficient measures and reduce policy distortions in order to grow their economies sustainably. According to the OECD, almost half of support to the agricultural sector did not benefit the environment or improve food security.[46]

Agricultural support varies from country to country. Among high-income countries, price incentives and fiscal subsidies remain the most widely used measures. Middle-income countries include those that have strongly subsidized agriculture (e.g., Indonesia and Turkey) or have already started reforming their agricultural supports (e.g., Brazil and China). There are also middle-income countries with policies that keep domestic food prices low to protect the impoverished, working poor and those experiencing food insecurity (e.g., in Argentina and India). The latter is more prevalent in most low-income countries.

International institutions, regional development banks, national banks, small/micro loans of private banks, and multinational and private companies provide other sources of financing. Digitalization facilitates financial exchanges and transactions in an easier and less expensive way, reducing transaction costs and making fintech one way through which investors in private markets aid in agricultural development. In addition, investors could participate in agricultural development through investments in companies that work toward improving agricultural technology, source agricultural produce from local or small farmers, or facilitate selling and marketing of the agricultural produce.

## Technology development in food production

Agricultural innovation will potentially support more sustainable land practices, more resilient crops and higher crop yields. Many policymakers and private businesses embrace agricultural technology as a solution for food security. However, the hand hoe remains a

primary tool for nearly 500 million smallholder farmers who grow nearly three quarters of the food consumed in Africa and Asia.[47] These farmers lack the necessary capital for rural development and transformation, including natural, built, human, social, political and financial capital.[48] However, Africa's farming sector accounts for more than 30% of the continent's GDP and employs more than 60% of the working population.[49]

Other delays lie in public opinion. In China, for example, consumer concerns over genetically modified organisms (GMOs) delayed progress toward genetically modified crops. However recently, China developed a roadmap to bolster the country's innovation capacity in agricultural science and technology to safeguard its food security.[50]

**Rapidly developing technology to control and influence the environment includes cloud seeding, which could help bring rain to drought-stricken areas.**

Understandably, countries that have a lower cost of labor and a larger share of agricultural employment could be slow to adopt modern technology in agriculture. In contrast, countries that have higher labor costs could be driven toward greater adoption of modern technology in agriculture. This includes blockchain-based food tracking, spoilage preventative packaging, GPS geolocating of crops, etc.

Rapidly developing technology to control and influence the environment includes cloud seeding, which could help bring rain to drought-stricken areas. Other farming technologies, such as drip irrigation, seawater harvesting and groundwater conservation have all played a part in improving food production, especially in regions that are arid with an inhospitable climate.

Some other agricultural technology solutions could include more genetic research, geospatial information gathering, drones and disaster robotics, data gathering and analytics, and automated assessments to prevent disasters.

As in any industry, modern agricultural technology must include cost-effectiveness. Some innovations, like vertical farming, require significant electricity consumption. Countries with predominantly smallholding farmers may slowly adopt modern technology and may continue to rely on traditional modes of agriculture for longer, possibly by increasing protection of their agricultural lands. Water stress and dependency on pesticides and fertilizers could intensify the move toward modern technology.

Nonetheless, as technology becomes less expensive over the longer term, jobs could shift to other sectors and require higher skillsets. Government expenditure will likely focus on skill development, education and retraining, which would be key especially in emerging and developing countries. Inequality among countries could increase without undertaking corrective actions in time. A high percentage of economic dependency on agriculture with more low-skilled population is one of the factors to define this dividing line.

**According to the United Nations, a third of food produced for human consumption gets wasted globally. This amounts to about 1.3 billion tons of wasted food per year, worth approximately US$1 trillion.**

## Preventing food wastage

According to the United Nations, a third of food produced for human consumption gets wasted globally. This amounts to about 1.3 billion tons of wasted food per year, worth approximately US$1 trillion.[51] All the food produced but never eaten could feed two billion people. That is more than twice the number of undernourished people across the globe. Consumers in Europe and North America waste almost as much food as the entire net food production in sub-Saharan Africa each year.[52]

Food wastage arises not only from consumers but also due to logistics issues. Food technology can reduce food waste, especially if the waste is due to movement, storage and packaging— transportation from farm to fork. Building energy-efficient cold storage facilities,

chemical preservation techniques, smart packaging systems, and use of smart labelling systems can help. These technologies can lengthen the shelf life of the food produce, and provide useful information about freshness, dynamic pricing, and easy monitoring. This can channelize the distribution of the food produce efficiently while creating intelligence about consumer demand and allowing producers to plan the supplies accordingly.

Governments crucially contribute to setting the roadmap for curtailing food waste, including incentivizing businesses and consumers. Regulations, tax benefits and subsidies comprise part of the solution, while creating a physical, monetary and intellectual infrastructure may be a larger incentive. However, private companies would also importantly contribute to any new spheres of development.

China's government, for instance, launched a "Clean Plate" campaign in August 2020 to prevent its people from wasting food. Targeting restaurants, the environment where consumers waste the most, the Chinese government adopted an anti-food waste law that gives restaurants the right to levy fees on consumers who have excessive quantities of food leftovers.

# Case studies

### Brazil: Network of support drives productivity

Brazil ranks as a major producer of basic crops and other goods. Despite its location fraught with climate-change adversities, since the 2000s Brazilian production and exports of basic crops and products increased considerably, notably to the United States, Europe and China. Brazil enhanced its agricultural productivity while also decreasing poverty and inequality.

The tools that helped drive higher exports include support of agricultural reforms, subsidies, state-funded agricultural research institutes, free-market pricing policies, modern technology, access to international markets through large multinational agribusiness companies, and good availability of arable land.[53]

Brazil also has competitive cost advantages over the United States, such as lower production costs for corn and soybeans.[54] Competitive costing helps countries achieve higher exports, while providing the ability to lower expenditures from government support.

Non-domestic investment and support has also helped Brazil. Brazil has the largest International Fund for Agricultural Development (IFAD) portfolio in Latin America, corresponding to about 50% of the portfolio since the country is a major agricultural power and the strongest country in the region. Brazil has about 49% of the arable land in South America.[55] IFAD focuses on family led farming that accounts for up to 70% of the country's staple food production, employing 75% of the farm labor force and generating 33% of the agricultural income.[56]

Brazil demonstrated that combined efforts of government, non-domestic investment and multinational corporations focused on specific aspects of agricultural development can lead to tangible results. It helped create an environment for agricultural prosperity—fiscal, monetary and political environment.

**Extreme climate conditions in South America present possible additional headwinds over the short term. Brazil previously implemented drought-resistant seeds that may help reduce the adverse drought impacts. Argentina (along with Colombia) would likely benefit from initiatives like the European Union's "Resilient Food," which focuses on small and family-run farming exposed to climate change.**

Brazil's dependency on imported fertilizers remains an area for improvement, as it imports 80%–90% of its fertilizer usage. The launch of its national plan to reduce import dependency came as a result of the war in Ukraine, since the country heavily depends on Russia for its fertilizer imports.[57]

### Argentina: Headwinds on multiple fronts

Argentina ranks as another large producer of basic crops and other exported products in South America, and Argentina has competitive cost advantages over the United States.[58] The primary South American producer and exporter of wheat, Argentina accounts for about 7% of its global exports. However, the country's agricultural growth has not increased as remarkably as Brazil.

Government support to producers in Argentina declined since the beginning of the 2000s, due to export taxes that depress the domestic prices producers receive. The elimination of export taxes in December 2021 for many food items did not affect key foodstuffs such as soybeans and beef, which remain highly taxed. Nonetheless, Argentina's agricultural production and exports grew in the last two decades due to an innovative private sector combined with public service support, particularly for knowledge, research extension and sanitary inspection.

Currency depreciation and high inflation in Argentina could weigh on the crop production amid higher costs of imported agricultural inputs. Like Brazil, Argentina imports about 70%–80% of its fertilizers.

Extreme climate conditions in South America present possible additional headwinds over the short term. Brazil previously implemented drought-resistant seeds that may help reduce the adverse drought impacts. Argentina (along with Colombia) would likely benefit from initiatives like the European Union's "Resilient Food,"[59] which focuses on small and family-run farming exposed to climate change.

### China: Climate and water stress

China has reduced the portion of its population living in extreme poverty over the past few decades with the help of economic opportunities, as well as support for people living with poverty.[60] As per World Bank, China contributed close to three-quarters of the global reduction in the number of people living in extreme poverty.[61]

China's agricultural policy focuses on self-sustainability and therefore, on domestic production. China imports 16% of its staple food needs, including its major import soybeans, while producing

most of the other staple foods domestically.[62] With more domestic production and worsening climate conditions, the focus on agricultural development will certainly increase.

Water stress and drought remain concerns. China continues to support irrigation facilities, and many consider its cloud-seeding program as the biggest in the world.[63] While China can influence rain to an extent through cloud seeding, its effectiveness needs proof, requiring continuous research within the country and internationally. The government encourages and invests in modern technology to improve agricultural productivity and sustainability.

While China manages its food security, social tensions could potentially arise due to high youth unemployment amid higher inflation and lower incomes. Increasingly, the reduction in poverty and the rising middle-income group led to a structural shift in food demand, where better quality and nutrition are important considerations.

### India: Ample human resources, strained elsewhere

India, with its large population, also faces climate-change issues. Its large rural population depends on agriculture as a primary income source, while the sector employs more low-skilled labor. With a high number of the population living under the poverty line, the government is under pressure to provide support to the population apart from its support to farmers.

Agriculture in India is about 60% rainfed. Additionally, according to the Food and Agriculture Organization of the United Nations (FAO) Aquastat database, agriculture utilizes 90% of freshwater withdrawals in India, significantly higher than the global average of 70%.[64] Thus, water stress will likely increase, and irrigation infrastructure facilities desperately need to improve.

India's government provides support to the agriculture sector through various programs aimed at irrigation facilities, price support, credit availability and supply chain development. These have yielded results but must improve significantly amid government announcements of three agricultural reform bills (in September 2020) that would allow farmers to sell their produce easily, harness new innovations, and stay updated with market knowledge. In addition, to encourage sustainable agriculture techniques, the government launched its National Mission for Sustainable Agriculture in 2015.

**India produces high amounts of agricultural waste during transportation. About 40% of the food is wasted due to an inadequate logistics, according to the National Agricultural Cooperative Marketing Federation (NAFED)'s estimates, and this adds pressure on food insecurity problems.**

The implementation of the new programs could depend on the level of skills prevalent in its agricultural sector. Hence, the high percentage of low-skilled employment in agriculture remains a key issue. Agriculture accounts for about 43% of the country's overall employment,[65] with half of the workers in low-skilled employment.[66]

India produces high amounts of agricultural waste during transportation. About 40% of the food is wasted due to an inadequate logistics, according to the National Agricultural Cooperative Marketing Federation (NAFED)'s estimates,[67] and this adds pressure on food insecurity problems. The government introduced a new policy called "National Logistics Policy" in September 2022 to improve transportation, aiming to save time and money.

On the positive side, India has gained self-sufficiency in production of wheat, rice and corn, and no longer depends on imports to feed its population. However, it depends on imports for about 41% of its fertilizer usage.[68]

# Conclusion

The COVID-19 pandemic and Russia's invasion of Ukraine placed food insecurity at the forefront. Food insecurity intensifies when people can no longer afford basic needs, and experience poverty, war and conflicts, and climate change. The development of a sustainable future must be a collaboration between the local population, governments and investors.

**However, the success of modern technology not only depends on current knowledge but on a plethora of factors that help build a network of support with multiple stakeholders: government measures, multinational companies, diplomatic relations, input suppliers, research development and skills.**

Agriculture sits at the core of sustainability. It affects the ability to provide necessities and to provide employment. It impacts the environment as deforestation and carbon emissions could increase, making it harder to achieve net-zero goals. Governments globally influence agricultural policies and reforms, especially in emerging and frontier markets. More importantly, climate change impacts a country's food production, water access and more.

Across regions, as derived from our Country Risk Framework, African countries present the most intangible investment risk; managing food security and access remains challenged from climate change, poverty, and food weights in the consumption category, among other aspects. Our Country Risk Framework suggests countries such as Pakistan and Bangladesh are vulnerable as well. Additionally, these countries have populations with lower income[69] and low-skilled employment in agriculture.[70] Policy reforms could change the course of these countries' progress and assessments in the future.

Water stress, including flooding and drought, greatly affect food production. While countries like China and India manage their water stress and aim for self-sufficiency in grain production, the ongoing impacts of climate change amplify water stress problems.

Investors play a critical role in the development of food technology through funding the initiatives of private companies. The United States, Canada, and Brazil have adopted food technology—like urban farming, vertical farming and other food production innovations—with the aim of improving yield, efficiency and profitability. As modern technology progresses, we have seen newer methods of food production gain traction, such as gene editing, that face fewer global regulations than GMOs.

However, the success of modern technology not only depends on current knowledge but on a plethora of factors that help build a network of support with multiple stakeholders: government measures, multinational companies, diplomatic relations, input suppliers, research development and skills.

Government support for agriculture differs from country to country. Even with rising interest rates, demand for financing agricultural development, and elevating debt-to-GDP ratios, governments should prioritize policies and actions toward food production quantity and nutrition in a sustainable manner, fostering positive outcomes. The capacity to raise more debt under such circumstances could critically narrow the food insecurity gap. In addition, trust in government, its executive capabilities and its financial capacity arguably determines a country's ability to support itself.

Many countries struggle with the need for improving food security, energy security, and addressing climate change. Collective efforts with government, (multinational and private) companies, farmers, financial institutions and investors working in tandem are critical in moving countries closer to food security goals. At the same time, investors are provided opportunities and potential returns from active portfolio management and country allocation.

## Contributor

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1. Source: The Global Report on Food Crises, 2022.
2. Source: Tran, T. "The State of the Food Industry, and How FoodTech Startups Are Creating a New Normal for All." Applico Blog. May 20, 2020.
3. Source: World Health Organization.
4. Source: Food and Agriculture Organization of the United Nations.
5. Source: Soffiantini, Giula. "Global Food Security. Food insecurity and political instability during the Arab Spring." September 2020.
6. Source: Reuters. April 2022.
7. The countries with lower scores tend to have a higher infant and maternal mortality rates, based on statistically significant results from our analysis.
8. Higher demand for food can theoretically be addressed by increasing land designated for agriculture. However, according to the Food and Agricultural Organization of the United Nations, agricultural expansion drives almost 90% of global deforestation. This is exacerbated by the growing demand for land for urbanization, at the cost of agriculture and food production.
9. Source: World Bank. "The Global Findex Database." 2021.
10. Ibid.
11. Source: World Bank Report. 2012.
12. Notably the second goal of the UN SDG: "End hunger, achieve food security and improved nutrition and promote sustainable agriculture."
13. The assessment is based on the latest data available as of November 2022.
14. Source: *The Guardian*. "Third of global food production at risk from climate crisis." May 14, 2021.
15. Ibid.
16. Source: UN Food and Agriculture Organization, FAO. "The impact of disasters and crises on agriculture and food security." 2021.
17. Source: World Resources Institute. "3 Maps Explain India's Growing Water Risks." February 26, 2015.
18. Source: Taheripour, Farzad; Tyner, Wallace E.; Sajedinia, Ehsanreza; Aguiar, Angel; Chepeliev, Maksym; Corong, Erwin; de Lima, Cicero Z.; Haqiqi, Iman. "Water in the Balance: The Economic Impacts of Climate Change and Water Scarcity in the Middle East." World Bank. 2020.
19. Ibid.
20. Source: United Nations. "As the climate dries the American west faces power and water shortages, experts warn." August 2, 2022.
21. Source: AGU. "Water Scarcity Predicted to Worsen in More Than 80% of Croplands Globally This Century." May 5, 2022.
22. Source: Liu, X., Liu, W., Tang, Q., Liu, B., Wada, Y., & Yang, H. "Global agricultural water scarcity assessment incorporating blue and green water availability under future climate change. Earth's Future." Advancing earth and space science (AGU). 2022.
23. Ibid.
24. Source: World Population Review web site.
25. Source: FAO. "The impact of disasters and crises on agriculture and food security: 2021." June 4, 2021.
26. Ibid.
27. Source: *Financial Express*. "Climate-change sowing poor nutrition." June 13, 2022.
28. Source: FAO. International year of plant health web site. 2020.
29. Source: World Bank. "The Locust Crisis: The World Bank's Response." July 1, 2020.
30. Source: FAO. "FAO appeals for urgent support to fight worsening Desert Locust upsurge in the Horn of Africa." January 30, 2020.
31. Source: IPCC. "Climate Change and Land—an IPCC Special Report on climate change, desertification, land degradation, sustainable land. management, food security, and greenhouse gas fluxes in terrestrial ecosystems." January 2020. There is no assurance that any estimate, forecast or projection will be realized.
32. Source: IFPRI blog, "From bad to worse: How Russia-Ukraine war-related export restrictions exacerbate global food insecurity." April 13, 2022.
33. Source: United Nations. "Feeding the World Sustainably." June 2012. The estimate could be higher, given the revised forecasts of the world population provided by the UN Population Division in its World Population Prospects, 2022. There is no assurance that any estimate, forecast or projection will be realized.
34. Source: Gaon Connection. "Rice and wheat in India are lot less nutritious than they were 50 years ago." June 24, 2021.
35. Quality Healthcare definition from data gathered by V-Dem. Quality healthcare means available healthcare adequately treats preventable and treatable illnesses that render individuals able to work, participate in social or political organizations, or vote (where voting is allowed).
36. From these countries, Nigeria, Pakistan, Turkey, and Thailand are due to hold elections in 2023. This raises the risk of fiscal slippages as political leaders seek to boost their popularity with platforms for greater spending or lower taxes.
37. Maslow's hierarchy of needs is an idea in psychology proposed by American psychologist Abraham Maslow in his 1943 paper "A Theory of Human Motivation" in the journal *Psychological Review*.
38. The MOVE (Merrill Lynch Option Volatility Estimate) Index indicates the implied volatility in the US bond market. The CBOE Market Volatility Index measures market expectations of near-term volatility conveyed by S&P 500 stock index option prices. Often called the "fear gauge," lower readings suggest a perceived low-risk environment, while higher readings suggest a period of higher volatility. The Economic Policy Uncertainty Index is a daily news-based index based on newspapers in the United States.
39. Source: OECD Economic Outlook. Volume 2022 Issue 1.
40. The interest payments as a percentage of GDP are as per Franklin Templeton Institute's calculations based on data from the IMF World Economic Outlook, October 2022. Brazil data as of 2022.
41. Source: IMF blog, "Africa Food Prices Are Soaring Amid High Import Reliance." September 27, 2022.
42. Source: World Economic Forum. "Climate change and food: The potential impact on production and prices." December 23, 2021. Refers to W. S. Jang, J. C. Neff, Y. Im, L. Doro, and J. E. Herrick "The Hidden Costs of Land Degradation in US Maize Agriculture." December 16, 2020.
43. Source: US Department of Agriculture. "Impacts and Repercussions of Price Increases on the Global Fertilizer Market." June 30, 2022.
44. Source: International Fertilizer Development Center. "Soaring Fertilizer Prices: A Threat to Food Security in Sub-Saharan Africa." December 20, 2021.
45. Source: International institute for sustainable development (IISD) SDG Knowledge Hub. "Country Profiles Reveal Global Cost of Land Degradation." May 17, 2018.
46. Source: OECD. "Agriculture Policy Monitoring and Evaluation 2021: Addressing the Challenges Facing Food Systems," June 2021. Note: Certain incentives may lead to higher input use of pesticides, the allocation of land to only those crops that do not support crop rotation and increased agricultural land by reducing forestation. Market price interventions are considered detrimental as they could potentially cause inefficient allocation of resources.
47. Source: "Viewpoint. Smallholders can feed the world." International Fund for Agricultural Development.
48. Source: International Fund for Agricultural Development. "Rural development report: fostering inclusive rural transformation." Rome: International Fund for Agricultural Development, 2016.
49. Source: Auda-Nepad African Union Development Agency.
50. Source: Maina, Jospeh. "China pushes ahead with GMO crops to safeguard food security." January 21, 2022.
51. Source: World Food programme's article titled "5 facts about food waste and hunger." June 2, 2020.
52. Source: FAO. "Cutting food waste to feed the world." May 11, 2011.
53. Source: Carlos Bacha and Leandro Vinicios de Carvalho. "What explains the intensification and diversification of Brazil's agricultural production and exports from 1990 to 2012?" International Research Initiative on Brazil and Africa (IRIBA) Working Paper 2. August 2014.
54. Source: US Department of Agriculture. "Corn and Soybean Production Costs and Export Competitiveness in Argentina, Brazil, and the United States." July 2016.
55. Source: Franklin Templeton Institute calculations based on 2020 data from FAO.
56. Source: International Fund for Agricultural Development (IFAD). Accessed the site on October 17, 2022
57. Source: Franklin Templeton Institute calculations based on 2019 data from OEC. Russia and Ukraine together provided 28% of Brazil's fertilizer imports.
58. Source: US Department of Agriculture. "Corn and Soybean Production Costs and Export Competitiveness in Argentina, Brazil, and the United States." July 2016.
59. Source: Euroclima resilient food web site.
60. Source: The State Council Information Office of the People's Republic of China. "Poverty Alleviation: China's Experience and Contribution." April 2021.
61. Source: World Bank. "Lifting 800 Million People Out of Poverty—New Report Looks at Lessons from China's Experience." April 1, 2022.
62. Source: Franklin Templeton Institute calculations based on 2019 data from FAO. The staple foods considered here are wheat, rice, and corn. China imports 5,858, 4,422 and 9,785 thousand tons of wheat, rice and corn out of it 1,26,435, 2,09,017, and 2,79,219 thousand tons of domestic supply, respectively.
63. Source: *CNN*. "China is seeding clouds to replenish its shrinking Yangtze River." August 18, 2022.
64. Source: FAO Aquastat database. 2020 data.
65. Source: World Bank. 2019 data.
66. Source: Franklin Templeton Institute calculations based on 2019 data.
67. Source: MoneyControl. "MC Explains: Challenges the govt needs to address to make the National Logistics Policy a success." September 19, 2022.
68. Source: Franklin Templeton Institute calculations based 2020 data from FAO.
69. Source: World Bank. Pakistan's and Bangladesh's GDP per capita is US$1,537.9 and US$2,503.0, respectively, 2021 data.
70. In Pakistan and Bangladesh, 23% and 48% of the employment in agriculture have low skills, as per Franklin Templeton Institute calculations based on International Labour Organization's data; 2019 and 2017 data respectively.

WHAT ARE THE RISKS?

**All investments involve risks, including possible loss of principal. The value of investments can go down as well as up, and investors may not get back the full amount invested.** Bond prices generally move in the opposite direction of interest rates. Thus, as prices of bonds in an investment portfolio adjust to a rise in interest rates, the value of the portfolio may decline. Stock prices fluctuate, sometimes rapidly and dramatically, due to factors affecting individual companies, particular industries or sectors or general market conditions. Investing in the natural resources sector involves special risks, including increased susceptibility to adverse economic and regulatory developments affecting the sector—prices of such securities can be volatile, particularly over the short term. Small- and mid-capitalization companies can be particularly sensitive to changing economic conditions, and their prospects for growth are less certain than those of larger, more established companies. Special risks are associated with investing in foreign securities, including risks associated with political and economic developments, trading practices, availability of information, limited markets and currency exchange rate fluctuations and policies; investments in emerging markets involve heightened risks related to the same factors. Sovereign debt securities are subject to various risks in addition to those relating to debt securities and foreign securities generally, including, but not limited to, the risk that a governmental entity may be unwilling or unable to pay interest and repay principal on its sovereign debt. Investments in fast-growing industries like the technology and health care sectors (which have historically been volatile) could result in increased price fluctuation, especially over the short term, due to the rapid pace of product change and development and changes in government regulation of companies emphasizing scientific or technological advancement. Real estate securities involve special risks, such as declines in the value of real estate and increased susceptibility to adverse economic or regulatory developments affecting the sector. Any companies and/or case studies referenced herein are used solely for illustrative purposes; any investment may or may not be currently held by any portfolio advised by Franklin Templeton. The information provided is not a recommendation or individual investment advice for any particular security, strategy, or investment product and is not an indication of the trading intent of any Franklin Templeton managed portfolio. Franklin Templeton and our Specialist Investment Managers have certain environmental, sustainability and governance (ESG) goals or capabilities; however, not all strategies are managed to “ESG” oriented objectives.

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