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The Shrinking Buffer

Climate change and the fragility of food

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Executive summary

The global food system is under long-term threat from climate change. Through 2027, it will face three more immediate tests of its capacity to withstand disruption. The latest 'super' El Niño is building towards a record-breaking peak around the end of the year. The closure of the Strait of Hormuz has constrained fertiliser supplies, particularly phosphate. Intensified attacks on Black Sea grain terminals have affected wheat exports.

Each crisis tests a different link in the food system: El Niño threatens the productive capacity of crops and livestock; disruption in the Gulf constrains access to the inputs needed to grow food; attacks on Ukrainian grain infrastructure damage storage and export capacity. Meanwhile, conflict-related disruption to trade routes compounds the risks across the system.

The consequences for global food systems will reverberate through 2027 and beyond, with severe impacts on communities at the sharp end of food shortages. The United Nations (UN) World Food Programme estimates that an additional 49 million people could be pushed into acute hunger globally by this year's El Niño alone.[1]

These crises foreshadow longer-term risks to the food system, as the undercurrent of a changing climate could erode the food system's capacity to absorb episodic shocks in three ways:

1. by increasing the frequency with which ambient temperatures exceed the optimal ranges for food production;
2. by heightening the potential for simultaneous failures across multiple breadbaskets; and
3. by amplifying the risk of climate tipping points that could compound these effects.

The resulting pressures will extend beyond domestic production to expose vulnerabilities across global food supply-chains. More volatile and uncertain production, together with rising friction in food trade between countries, could see a persistent inflationary floor that weighs on household purchasing power, tightens monetary policy and the availability of credit, and dampens economic growth over the longer term. This will likely elevate food security on political agendas, with governments placing a growing premium on reliable access to food.

To meet this challenge, policymakers should take a whole-of-government approach to food security and resilience, strengthening the buffers needed to absorb shocks to the global food system. In the context of the current crises, this begins with mapping critical dependencies through supply-chains and stress-testing national and global food systems against shocks such as simultaneous harvest failures, fertiliser disruptions and export restrictions. Public and private finance should mobilise capital to shore up the dependable productive capacity of the food system.

Investors should recognise that the food system will be on the front line of where climate change will translate into real-economy impacts: rising temperatures and climatic volatility will feed through to lower food production, supply-chain disruption, higher inflation and weaker economic growth – and ultimately to asset prices and financial stability. Investors should ensure that climate scenario models shaping their long-term asset allocation capture these interconnected food-system risks.

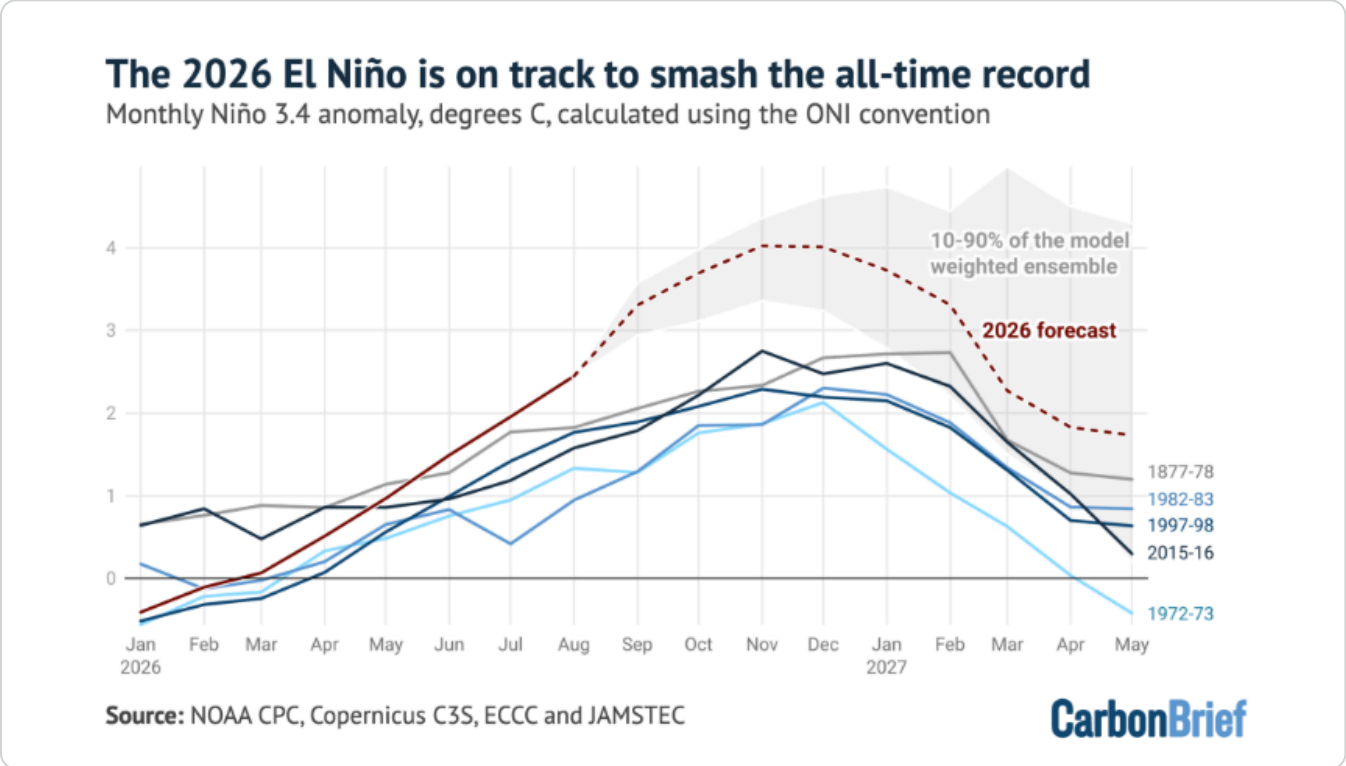
Near-term challenges to the food system

A record El Niño, a closed Strait of Hormuz and attacks on Black Sea grain infrastructure are each testing a different link in the chain.

El Niño

The latest El Niño is likely to be exceptional, with sea-surface temperatures expected to peak around the end of the year at approximately 4°C above normal, significantly warmer than the previous record (from 2015) of 2.72°C.[i] This will amplify the anomalous – and often extreme – weather patterns associated with El Niño, impacting food production around the world.

FIGURE 1 **The 2026 El Niño is on track to smash the all-time record**



Monthly Niño 3.4 anomaly, °C, calculated using the ONI convention Source: Carbon Brief[2]; NOAA CPC, Copernicus C3S, ECCC and JAMSTEC.

i The US National Oceanic and Atmospheric Administration's (NOAA) Niño 3.4 index of sea surface temperatures recorded a new monthly peak anomaly of 2.82°C for September 2026, surpassing the previous high of 2.72°C from November 2015, even though this El Niño still has some months to go before its peak. https://www.cpc.ncep.noaa.gov/data/indices/sstoi.indices ↩

Some notable examples in the last few months that already bear the fingerprints of this year's El Niño include:

- Delayed rainfall in Brazil that has exposed the Amazon to heightened wildfire risk, with a 253% increase in fires reported in the first two weeks of October compared to the same period last year. Scientists and officials are attributing this to El Niño combined with climate change.[3]
- A weaker June-to-September monsoon season in India with 13% less rainfall than usual *"as the El Niño weather pattern dampened precipitation"*.[4] The monsoon season is crucial to India's rice harvest: the country is the world's largest rice producer, and rice is a staple food for half of the world's population.
- Rainfall in East Africa that has been *"substantially below average"*[5] (e.g. at just 45% or less of normal levels in northern Sudan). FEWS NET reports that *"El Niño-related rainfall deficits will contribute to reduced crop production and livestock productivity and higher food prices"*. Maize crops are likely to be significantly depleted, with a knock-on impact on cattle stocks in the region from feed scarcity.
- Unusually dry conditions in Indonesia, fuelling severe forest and peatland wildfires, with 1.9m hectares of land affected through September (compared to around 0.4m at the same point in 2024 and 2025).[6]

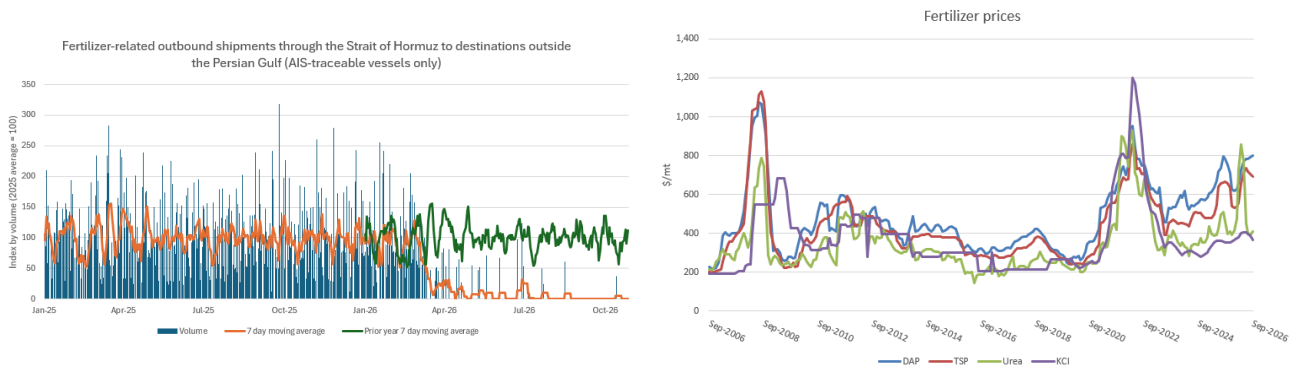
As well as impacting crop production, El Niño can impact livestock yields. Periods of extreme heat and humidity increase the risk of dangerous 'wet-bulb' conditions in which a body's cooling ability is severely impaired. This heat stress can reduce farm workers' capacity to work, while also increasing cattle mortality and compromising dairy yields, for example.

Middle East war and the Strait of Hormuz

The Middle East is a major producer of fertilisers, accounting for 47% of global seaborne trade in sulphur (a key component of phosphate-based fertilisers) and 35% of urea (nitrogen).[7] Consequently, up to 30% of international fertiliser trade passed through the Strait of Hormuz before the closure.[8]

The closure has resulted in fertiliser volumes from Gulf exporters in 2026 being sharply lower: for instance, nitrogen exports from Saudi Arabia are down 63% and from Qatar down 37%. On a global level, however, exports of nitrogen and phosphate are reported to be down only around 9% compared to last year, as other fertiliser-producing regions such as China and the US have been picking up much, if not all, of the slack.[9]

FIGURE 2 **Fertiliser shipments through the Strait of Hormuz, and fertiliser prices**



Left: fertiliser-related outbound shipments through the Strait of Hormuz to destinations outside the Persian Gulf (AIS-traceable vessels only). Source: WTO Data Lab[10]. Right: fertiliser prices. Source: The World Bank Commodity Price Data[11].

The reduced availability is not (yet) having a material effect on fertiliser prices (which account for around a quarter of total food production costs). The prices of DAP (from the phosphate and nitrogen family of fertilisers), TSP (inorganic phosphate) and MCI (potash) are only marginally up year-on-year.[ii] The price of urea (nitrogen family) saw an abrupt spike in March through May 2026, but then quickly reversed as China increased exports while demand from Brazil was lower than usual.

Despite the muted impact on prices, reduced availability of fertilisers on a global level will impact agricultural yields over the coming months. The disruption *"is already becoming visible in agricultural harvests, threatening to lower farm yields and push up food prices"* and although *"fertilizer and fuel stocks initially cushioned the shock, ... prolonged uncertainty has led to more cautious planting and reduced fertilizer use"*.[12] The longer the conflict persists, the more likely constrained availability will feed into food price inflation.

The Middle East war is also impacting the cost of transporting food itself (which accounts for around 5% of total food costs). Bunker prices are up over 80% year-on-year,[13] while container shipping prices are up 2.6 times in that period and bulk shipping prices are up 33%.[14, 15] The closure of the Strait of Hormuz together with Houthi attacks around the Red Sea is causing a re-routing of food transport, with the consequent increased mileage further adding to costs.

Russia and Ukraine

The third risk to food production comes from attacks since the summer on grain storage and export capacity in Russia's war on Ukraine. The two countries combined represent 14% of global wheat production and 27% of global wheat exports.[16]

Ukraine's grain exports were down nearly 37% year-on-year in September,[17] while Russia's grain exports fell 31% across July and August 2026, with September indicated as being down around 50%.[18] Oxford Economics estimates that wheat exports could be reduced by up to 86 million tonnes (mt) this year (52mt from Russia, 34mt from Ukraine).[19]

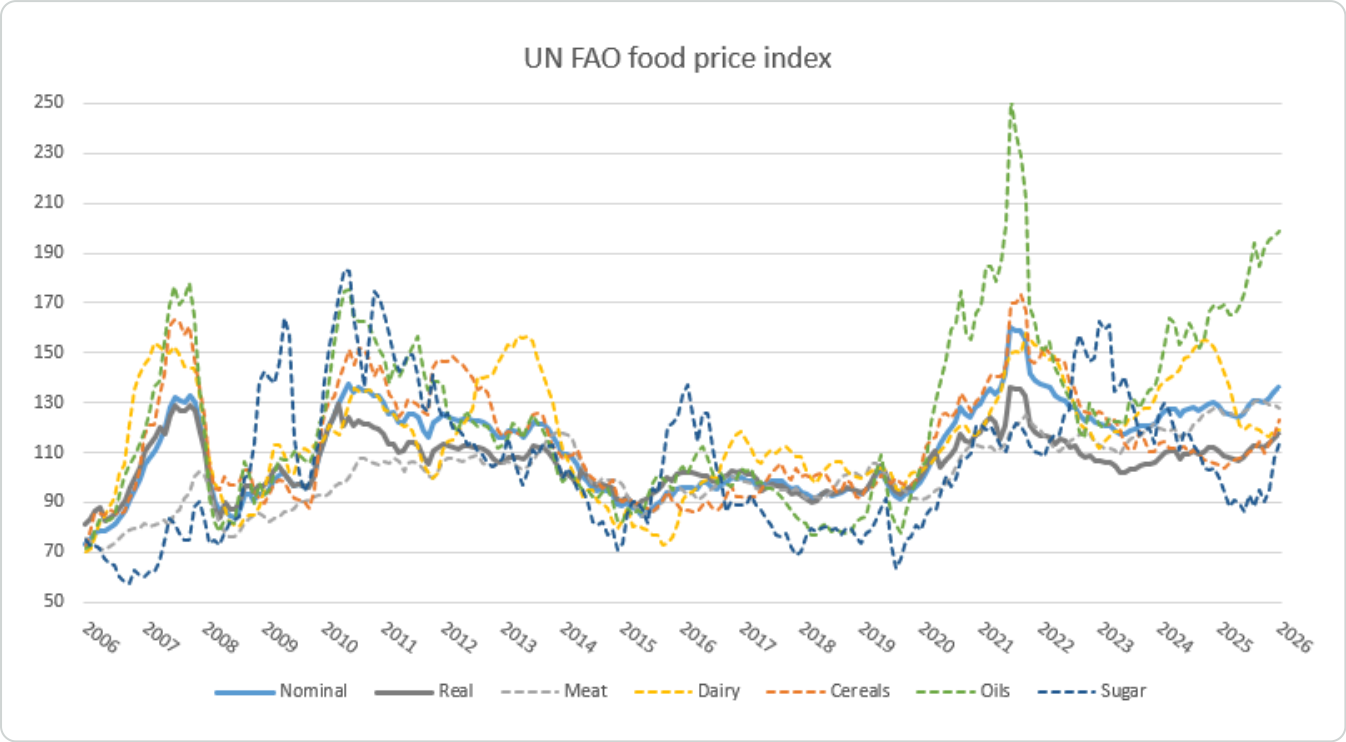
These impacts are being cushioned by high reserves following a bumper crop last year. Nevertheless, some countries remain particularly exposed. For instance, Egypt is the world's largest importer of wheat, with over 80% of imports coming from Russia and Ukraine (it lacks sufficient water to grow wheat domestically).[20]

Food prices on hold – for now

Overall, the current triple threat to food production is not (yet) translating into significantly higher food prices. The United Nations' Food and Agriculture Organization food price index was up 6% year-on-year in September but remains well below the peaks of 2022 (in the immediate aftermath of Russia's attack on Ukraine).[21]

ii DAP stands for Diammonium Phosphate, TSP for Triple Super Phosphate and MCI for Muriate of Potash (Potassium Chloride) ↩

FIGURE 3 **UN FAO food price index**



Nominal and real food price index with sub-indices for meat, dairy, cereals, oils and sugar, 2006–2026 Source: Food and Agriculture Organization of the United Nations (UN FAO).

Prices of cereal (which accounts for around 45% of the world's calories) are up 17% compared to a year ago but are slightly below their five-year average.[22] Wheat is the main driver within cereals, with prices up 31% year-on-year as heat and drought are already diminishing harvests in the largest producing countries. For example, Australian wheat output is projected to be down 17% for the 2026-27 season.[23] The heat in Europe this summer also impacted production, with yields expected to be down 7.5%.[24]

Futures markets tell a similar story, with the forward curves for wheat and corn modestly in contango (futures prices above the price of the physical contract), but with December 2028 contracts priced at less than 10% above spot. Sugar, cocoa and coffee curves are in backwardation (the futures prices are below spot prices).

Some commentators expect price pressure to emerge as the effect of the crises is felt into 2027 and beyond. For instance, Goldman Sachs has reportedly projected potential food commodity prices to increase by nearly 16% into the second half of 2028.[25] The OECD's latest economic outlook comments that food supply shocks from a very strong El Niño combined with continuing disruption to fertiliser supplies from the Gulf could see food prices up 10% in 2027 compared to its baseline projections.[26]

Perhaps this sanguine response in food commodity markets is understandable. The start of Russia's war on Ukraine produced a severe price shock, but global food systems adapted. Moreover, as ING notes, historically *"the impact on global agricultural output [of moderate to very strong El Niño events] has been fairly limited"*.[27] The last three very strong El Niño events each saw global average food prices fall: the UN FAO index fell 12% from the start of 1997 to the end of 1998, 6% across 2015-16 and 3% in 2023-24.

Of course, such global averages mask significant underlying differences. As Kotz et al noted, *"specific food goods can also experience much stronger short-term price spikes in response to extreme heat"*.[28] Global averaging is an abstract concept for those at the sharp end of localised price volatility.

Longer-term fragility

Stable average prices offer a potentially false sense of security. The deeper question is whether the system can keep absorbing shocks of this scale and frequency.

The relative stability in average food prices offers a potentially false sense of security, obscuring the deeper question of whether the food system can continue to absorb shocks of the current scale and frequency over the longer term.

Although there is some debate[iii] as to whether climate change is affecting the frequency or intensity of El Niño events, it is unsettling that the 2020s will be the first decade to record more than one 'very strong' El Niño since reliable records began.[iv] The World Meteorological Organization is clear that climate change can amplify the *impacts* associated with El Niño *"because a warmer ocean and atmosphere increases the availability of energy and moisture for extreme weather events such as heatwaves and heavy rainfall."*[29]

Or as UN Secretary-General António Guterres put it more forcefully: *"El Niño conditions will pour fuel on the fire of a warming world. Impacts will hit even harder, travel even farther, and cross borders with devastating speed."*[30]

The global food system does contain a variety of buffers, including uncorrelated breadbaskets, accessible reserves, food-type substitution, functioning trade and the financial capacity to withstand temporary pressures. However, the persistent undertow of climate change threatens a number of these buffers. For example, rising temperatures will potentially impact the shock-absorbing balance in the system by increasing the proportion of a growing season spent outside the optimal thermal limits for production, while also increasing the correlation of weather disruption across breadbaskets. Breaching climate tipping points threatens to amplify these effects.

Thermal limits of food production being tested

It is easy to envisage how extreme weather events such as drought or flooding can disrupt a season's crop production. But even absent such events, rising temperatures threaten food yields. For example, crops thrive within an optimal temperature range throughout the growing season. A rising baseline of temperatures *"narrow the 'thermal safety margin' species rely on for biological processes that support photosynthesis, cellular regeneration, reproduction and ultimately staying alive."*[31]

Agricultural crop yields begin to suffer *"above 30 degrees Celsius – lower for some crops such as potatoes and barley – leading to weakened cell walls, sterile pollens and the production of toxic oxidative compounds... [For] most major agricultural crops, the temperature failure point is reached when air temperatures exceed 35°C."* Meanwhile, heat stress for livestock *"...begins at above 25 degrees Celsius, and a bit lower for chickens and pigs, which are unable to cool themselves by sweating"*.[32]

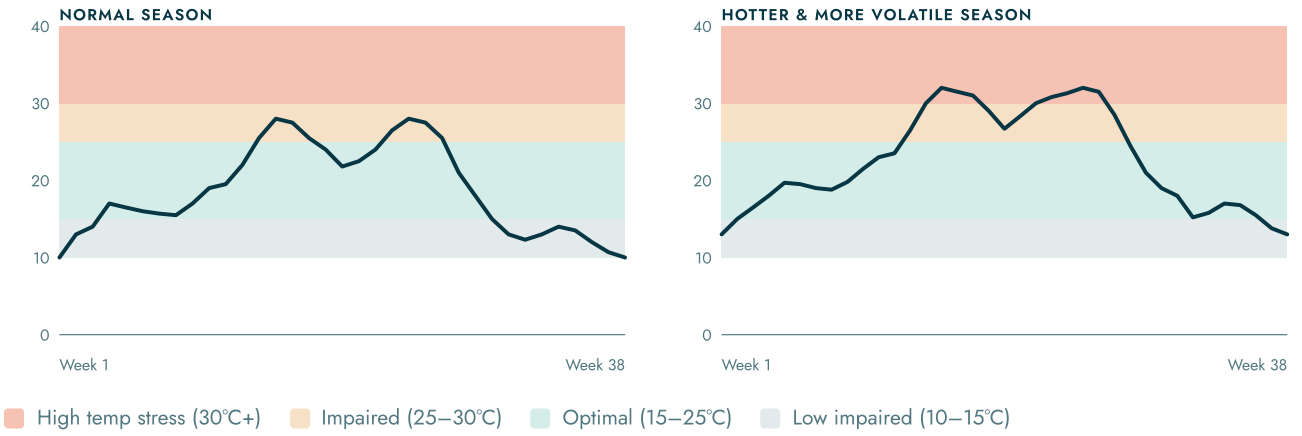
iii For instance, the New York Times reported that in a recent survey of 16 scientists, eight saw *"compelling evidence"* that climate change is increasing the intensity of El Niño events: https://www.nytimes.com/2026/06/19/climate/climate-change-el-nino.html ↩

iv The current El Niño is almost certain to count as 'very strong'. For the history, https://elninoguide.com/dashboard reports that there were no 'very strong' El Niño events in the 1950s, 1960s, 1970s and 2000s, while there was one in each of the 1980s, 1990s and 2010s. ↩

Further, more pronounced swings in weather conditions within the season also impact yields. Although seasonal conditions (drier or wetter, colder or warmer than normal) determine the production potential, short abnormal events determine how much of that potential is lost. For many major crops, a few days of extreme heat (particularly within a warmer than average season) at the wrong point in the crop's development (i.e. during pollination and flowering) can matter more than a modest change in the seasonal average. As the IPCC writes: *"short-term exposure of crops to temperatures beyond a critical temperature threshold can lead to lower yields and above a limiting temperature threshold, crops may fail altogether"*, particularly if a heatwave occurs *"during critical phenological stages"*.[33]

The charts below are a stylised illustration of how rising temperatures affect crop yields. In a 'normal' season (left), temperatures remain largely within the optimal range for crop production, with only brief periods above that range where yields may be modestly reduced. In a hotter season (right), higher baseline temperatures increase the length of time spent in the impaired range, while more frequent and severe extreme heat events place production under severe stress, bringing the risk of crop failure if sustained for more than a few days at the most critical points of the growing cycle.

FIGURE 4 **Illustrative temperature through a production season**



Source: Carbon Tracker Initiative and Planet Tracker – illustration

The likelihood of extreme heat days is roughly twice as high at 2°C of warming versus 1.5°C, and four times as likely at 3°C.[34]

There is evidence that climate change is already impacting agricultural yields. A 2025 report from the Proceedings of the National Academy of Sciences (PNAS) found that *"climate trends have caused current global yields of wheat, maize, and barley to be 10, 4, and 13% lower than they would have otherwise been"*.[35] Meanwhile, the IPCC reported in 2022 that *"Climate-related hazards that cause crop losses are increasing... Drought-related yield losses have occurred in about 75% of the global harvested area... The combined effects of heat and drought decreased global average yields of maize, soybeans and wheat by 11.6%, 12.4% and 9.2%, respectively."*[36]

Rising risk of simultaneous crop failures

Historically, increased exports from unaffected regions, together with the drawdown of food stocks, have cushioned production shortfalls linked to El Niño at the system-wide level. For instance, a 32% (or 13mt) decline in Australian wheat output in 2023-24 was offset by a 26% (3mt) increase in production in Argentina, 10% (4mt) in the US and 3% (3mt) in India.[37] In other words, resilience resided in the localised nature of crop failure, with shortfalls in one region offset by healthy production in others.

Climate change threatens that natural balancing function. A 2019 paper from Gaupp et al concluded that *"risks of simultaneous crop failure... increase disproportionately between 1.5 and 2°C"*, with the potential for multiple breadbasket failures reaching 54% for maize, or once every two years.[v] The report estimates the equivalent for wheat at once every 15 years and soybeans at once every seven years.[38]

In addition, supply-chain dependencies can increase the correlation of countries' exposure to weather shocks, as disruptions in one region cascade through globally interconnected markets for food, fertilisers and other agricultural inputs. Countries that might otherwise be insulated by different growing seasons or climatic conditions can therefore experience simultaneous shortages, as they compete for the same constrained supplies or depend on the same vulnerable trade routes. These risks could be amplified if governments prioritise national food security in response to domestic shortages, imposing export restrictions, stockpiling supplies or subsidising domestic markets.

Meanwhile, conflicts around the world are heightening governments' concerns about food security, reinforcing the imperative to safeguard reliable access to food in an increasingly volatile geopolitical environment. This could further weaken the counter-balancing function that has underpinned food systems to date.

Tipping points add a new dimension to food-system risk

Climate tipping points could fundamentally reshape the geographic distribution and reliability of global food production. Tipping points involve changes in the equilibrium of the Earth system which could potentially trigger irreversible shifts in regional climates. The University of Exeter writes that *"food systems are highly vulnerable to tipping points... Agricultural systems are strongly sensitive to changes in the functioning of a wide range of supporting systems in soil, water, pollination and natural pest suppression. Rapid environmental changes threaten to disrupt such functions in ways that are likely to impair agricultural production."*[39]

For instance, irreversible Amazon rainforest dieback could reduce rainfall and extend dry seasons, thus increasing heat and fire risk, and undermining crop yields and pasture productivity. Indeed, the current El Niño is likely to see significant Amazon drought, fuelling the risk of wildfires and offering a preview of this potential for rainforest ecosystem collapse.[40]

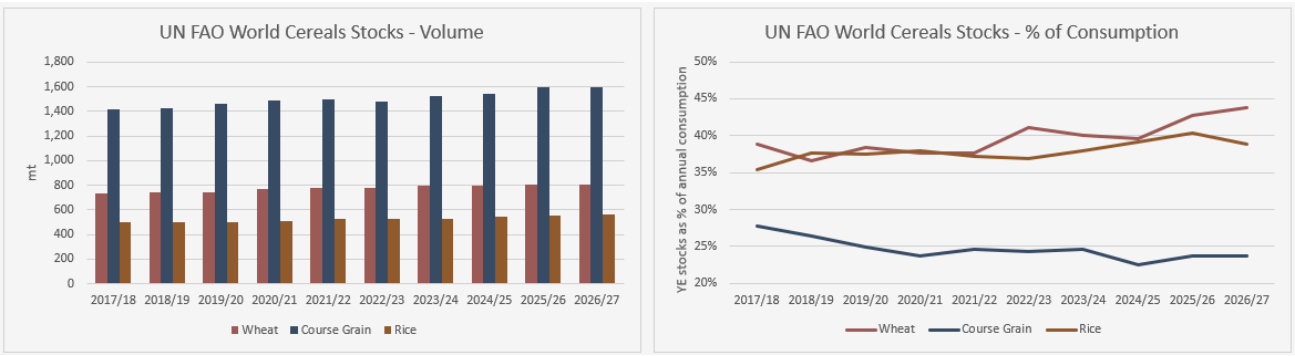
Another example is the potential collapse of the Atlantic Meridional Overturning Circulation (AMOC), which would see dramatically colder winter temperatures and shifts in rainfall across Northern Europe (even as average global temperatures continue to rise). This would significantly affect growing seasons, crop suitability and harvest reliability. The UK's Met Office reports that a collapse of the AMOC would *"affect agriculture, especially in Europe and parts of Asia and destabilise global food prices"*. It estimates that the share of land in Britain suitable for arable farming would fall from 32% to 7%.[41]

Food reserves may need to increase

Food reserves can help cushion the impact of supply shocks. Total cereal stocks have been steady at the equivalent of just over 30% of annual consumption over the last ten years:

v It should be noted that even at 1.5°C, the report estimates materially elevated risk of multiple maize breadbasket failures of 40% (once every three years) compared to 6% (once in 16 years) for the 0.85°C baseline scenario. At 1.5°C, the risks for wheat are once every 21 years (vs once every 43 years in the baseline), while soybean is once every nine years (vs one year in 20 in the baseline). ↩

FIGURE 5 UN FAO world cereal stocks



Left: volume, mt. Right: year-end stocks as a percentage of annual consumption, by cereal type, 2017/18–2026/27 Source: Food and Agriculture Organization of the United Nations (UN FAO)[42].

However, the stability of aggregate reserves may be less reassuring than it appears. As Generation Investment Management writes, *"Many people probably imagine that governments everywhere... hold food reserves sufficient to feed their people in case of crisis. It is, however, less true than it used to be. At a global scale, we more or less eat what we grow from year to year. Most governments depend on the just-in-time deliveries of the global trade system to keep their people fed."*[43]

Reserves equivalent to three months' global consumption may have been proportionate for the magnitude and frequency of supply shocks witnessed historically. However, reserves vary significantly from one country to another – countries with a history of exposure to drought, food disruption and famine are more likely to value a buffer. This concentration means reserves often fail to reach the countries where the need is most acute when supply shocks occur.

Moreover, this level of buffer may be insufficient to cushion against future shocks. As Generation Investment Management goes on to warn: *"A true global-scale interruption of food production – from, say, a massive volcanic eruption that blackened the sky for months, or from failures in multiple breadbaskets caused by climate change – would almost certainly produce chaos, panic and mass starvation."*

The economic cost of food-system fragility

Downward pressure on yields, punctuated by shocks, could put a permanent floor under inflation and strain a low-margin sector.

Inflationary pressure

To be clear, the expectation is not that climate change will trigger a rapid collapse in food production. A study from Hultgren et al in 2025 estimates that every 1°C of warming will reduce food production by 120 calories per person per day, or 4.4% of current consumption.[44] But that constant downward pressure on yields, exacerbated by periodic unbuffered shocks, could place a permanent floor under inflation. This in turn could create a potential dilemma for central banks with inflation-targeting mandates if food supply shocks coincide with soft underlying economic conditions. Food price inflation could drag on economic activity as food displaces non-discretionary spending in household budgets and if tighter monetary policy reduces credit availability, slows capital flows and increases debt service burdens.

The Potsdam Institute sized this impact in a 2024 report, estimating that climate-related shocks will add 0.9-3.2% to the annual rate of food inflation globally by 2035.[45] Meanwhile, a recent report from UBS pointed to elevated food price inflation over the longer term due to a combination of climate-related disruptions, extreme weather events and weak farm profitability limiting resilience investment, among other factors.[46]

More recently, various financial institutions have highlighted the vulnerability of emerging economies – where food typically accounts for between 20% and 50% of total consumer expenditure – to near-term El Niño-driven inflation risks:

- HSBC points out that *"if El Niño conditions strengthen through the summer, the next inflation test for EM could come from food prices... into 2027, complicating the monetary outlook for EM economies where food has a large weight in CPI baskets."*[47]
- Morgan Stanley notes that *"food inflation driven by El Niño could weaken growth and public finances in some Latin American and African economies, putting pressure on their sovereign credit... Ecuador, Mozambique, Zambia, Colombia, Costa Rica, and Peru are likely to be the most exposed, while Chile, Uruguay and Argentina could benefit."*[48]

Pressure on the food sector

Persistent food cost inflation could also strain the financial resilience of companies across the food value-chain. The sector typically operates at modest levels of profitability, with EBITDA margins sized in a report by Allianz at 8% for farming companies, 15% for food processors (albeit with only a 3% net margin) and 4% for wholesalers.[49] Food retailers' EBITDA margins average around the mid-single digits, or a little above. Low margins leave companies in the food value-chain exposed to inflation, presenting businesses with a difficult choice between passing on higher costs to consumers at the risk of lower sales volumes, or protecting volumes by absorbing some of the cost with a negative impact on profitability.

This potential vulnerability of the sector may be reflected in its underperformance against the overall market in recent years. MSCI's World Agriculture & Food Chain Index shows a notable underperformance versus the broader MSCI World Index since mid-2022.[50] The sector now trades at a substantial valuation discount to the overall market, at an average P/E multiple of 16.8x (compared to 22.7x on average for the MSCI World Index).

As Allianz writes: *"The key risk factors for the sector over the medium term are structural rather than cyclical. Climate change is increasing the frequency of extreme weather events that disrupt yields and logistics in ways that are difficult to plan around."*

A report from Inside Track, which convenes sector insiders, warns that the food sector may be unable to *"move towards complex supply chains, poorer yields and increased waste without affecting the ability of companies to repay debt, to hold profit margins and to grow"*. The report further notes that *"rising prices will also affect business resilience through weaker demand, new regulation, workforce impacts and political pressure."*[51]

This gloomy prognosis for a sector so fundamental to economic and human health is concerning and sends an additional warning signal about the potential fragilities of the food system in the face of supply shocks that are likely to become more frequent, correlated and significant over time.



Conclusions and recommendations

Whether markets are right to be sanguine about the near-term threats will be seen in time. What is more certain is that the system's capacity to absorb future shocks is likely to shrink as temperatures rise.

The triple threat from El Niño, the closure of the Strait of Hormuz and attacks on grain storage and transport in Ukraine and Russia constitutes a strict test of the resilience of the food system. Whether commodity markets, drawing from historical precedent, are right to be as sanguine as they currently are will be seen in time. What is more certain is that, for vulnerable communities around the globe, the cost of this confluence of crises will be severe.

The capacity of the food system to absorb future shocks beyond the immediate horizon is likely to reduce as temperatures rise, structurally altering the shape of a 'normal' season for key breadbaskets, increasing the number of extreme weather days at key points in the growing season, and increasing the correlation of supply disruptions across regions.

The food system will therefore be a major arena for the translation of climate change into impacts on the real economy and into increased risk for the financial system – both at the idiosyncratic level (with the potential for strained profitability and rising default risk for businesses along the food value-chain) and the systemic level (food inflation which could trigger monetary tightening and drag on economic capacity, combined with other risks including protectionism and social unrest).

Addressing the vulnerability of the food system is not an either-or choice between mitigation and adaptation. Both are required. Today's greenhouse gas emissions lock in rising stress on the food system tomorrow. Therefore, investment in adaptation is necessary. Yet adaptation finance into Agriculture, Forestry and Other Land Use (AFOLU) fell to $5.5 billion in 2024, down from $7.6 billion in 2022.[52] This compares to the UN's estimate of the *"cost of adaptation and residual damage to global crops at 2°C"* at $80 billion a year.[53]

Policymakers will have a critical role in determining whether future food-system pressures trigger a reactive cycle of crisis management or catalyse the structural changes needed to build resilience against a more volatile climate. As Tom Harris and Mark Roberts wrote in a recent post, policy reaction will determine *"whether trade stays open when exporters take fright of a food shortage, whether smallholders can access credit and improved seed, whether safety nets hold through the price spikes that are coming, and whether adaptation finance arrives before the shock or only in the wreckage, hunger and famine after it."*[54]

But as the UN went on to say in its 2023 Climate Summit note, *"beyond 2°C, adaptation measures won't be enough to prevent impacts on food production."* Therefore, the incentive for a firm focus on mitigating climate change remains intact.

The escalating issue of systemic climate risk is underlining the need for all parts of governments – those involved with trade, economic and financial policy as well as climate and energy – to work on a cross-cutting agenda that both builds resilience against, and mitigates the risks from, climate change. As food security, like energy security, falls increasingly into the category of 'national security', governments should ensure that the institutional machinery is in place to handle it across departments.

Recommendations for policymakers

1. **Prioritise food-system resilience as a national security and economic imperative.** Embed food security in national climate strategies, economic planning and risk management, recognising the implications of food-system disruption for inflation, public finances, social stability and geopolitical security. This will require a whole-of-government approach, ensuring the necessary institutional arrangements are in place across the relevant government departments and regulators to enable effective policy and decision-making.

2. **Stress-test food-system buffers and dependencies.** Assess national and international exposure to compound shocks, including simultaneous harvest failures, extreme heat, fertiliser shortages and disrupted trade routes. Map critical dependencies on imported food supplies, and evaluate whether strategic reserves, alternative sources and trade arrangements can withstand correlated disruptions.

3. **Scale up investment in both climate mitigation and food-system adaptation.** Accelerate emissions reductions to limit the severity of future climate impacts, while financing adaptation measures that protect agricultural productivity and food security. Prioritise solutions that strengthen resilience to both gradual warming and acute shocks.

4. **Create incentives for food-system companies to invest in resilience.** Align public procurement, agricultural support, tax incentives and access to finance with investment in climate-resilient food production, diversified sourcing and efficient input use. Encourage food companies to assess and disclose material climate risks and dependencies, and to demonstrate how they are addressing them.

5. **Protect the natural capital underpinning food production.** Integrate soil health, water security, biodiversity and ecosystem protection into agricultural and land-use policy, recognising that degraded ecosystems weaken the capacity of food systems to withstand climatic extremes.

6. **Strengthen international cooperation on food security.** Coordinate early-warning systems, climate-risk assessments and contingency planning for food systems; improve transparency around food stocks and critical input supplies; and reinforce predictable, open trade, particularly during crises.

Investors should recognise food insecurity and climate-driven supply shocks as potential sources of long-term portfolio risk, transmitting through persistent inflation, trade protectionism, social unrest and weaker economic growth.

Implications for investors

1. **Embed realistic food-system risks in climate scenario models.** Investors should incorporate risks such as the breaching of agricultural temperature thresholds and simultaneous breadbasket failures – and their cascading impacts on food prices, inflation and economic stability – into scenario models and asset price stress tests.

2. **Invest in climate-resilient food production.** Investors should engage companies across the food value-chain to scale investment in heat- and drought-tolerant crops, soil health, water efficiency and diversified production, while also directing capital towards adaptation opportunities that protect long-term productive capacity.

3. **Engage policymakers to strengthen resilience across the food system.** Encourage governments to stress-test critical dependencies and systemic vulnerabilities, and to adopt policies that protect food security against compound climate and supply-chain shocks. Advocate for credible, adequately financed adaptation plans across food-related value-chains, from agricultural production and processing to distribution and retail.

4. **Align investment and stewardship with limiting climate change.** Direct capital towards companies and solutions that support credible, science-aligned decarbonisation pathways. Use stewardship to challenge companies on emissions reduction targets, transition plans and capital allocation, encouraging action across food-related value-chains to reduce emissions while safeguarding long-term food security.

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