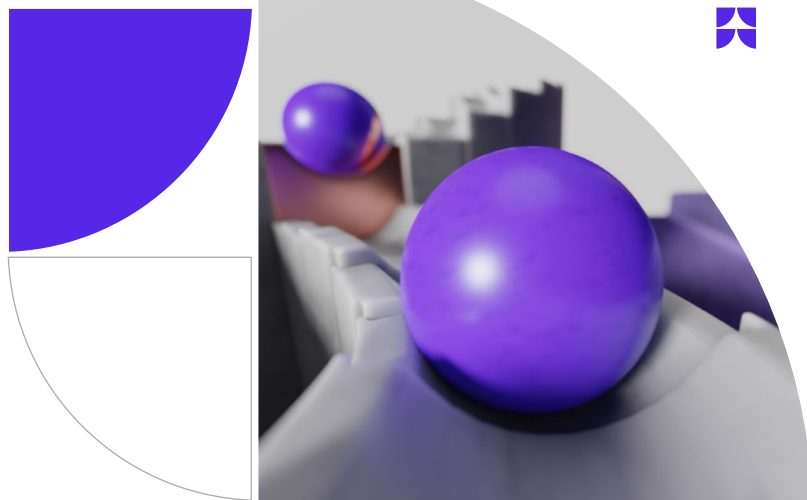




Questioning Consensus: The Future Is Now



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As we enter 2023, we believe the need to thoroughly evaluate climate change's market impacts has never been clearer. Physical repercussions are not a distant prospect. They are current, potentially dire risks whose market implications are just beginning to be thoroughly evaluated.

Consider several events of the past three years:

- Droughts and floods have exacerbated the impacts of COVID-19 and Russia's war in Ukraine, stressing agricultural and energy markets globally.
- Following 22 years of nearly continuous drought, California farmers expect to fallow 500,000 water-deprived acres over the next four years.
- Northern Europe suffered a 9-billion-euro economic loss in 2022 due to drought, on account of record-low water levels in the Rhine River and other major river corridors.



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Each of these events affected commodity and financial markets. Are they "one-offs"? Or do they mark the early stages of long-term secular shifts? Or both? We don't know, yet—and there's much to learn and consider. However, while the effects from COVID-19 and the invasion of Ukraine will likely subside over time, we believe the consequences of warmer temperatures are likely to grow more pronounced—magnifying market cycles and creating wider ranges for commodity and security prices with more volatility.

In our view, this challenging situation creates opportunities for strategic, purposeful investing with the goal of delivering financial benefits for investors while addressing changing risk dynamics. To capture these opportunities, we conduct rigorous fundamental analyses through a cross-asset-class lens to form clear, informed investment perspectives. Our approach requires a strong focus on intermediate and longer-term effects of a changing climate, including the influence on energy and food prices and differences across geographies.

To illustrate, we share two contemporary examples: the effects of heat-driven drought in the Mississippi River and Rhine River basins.



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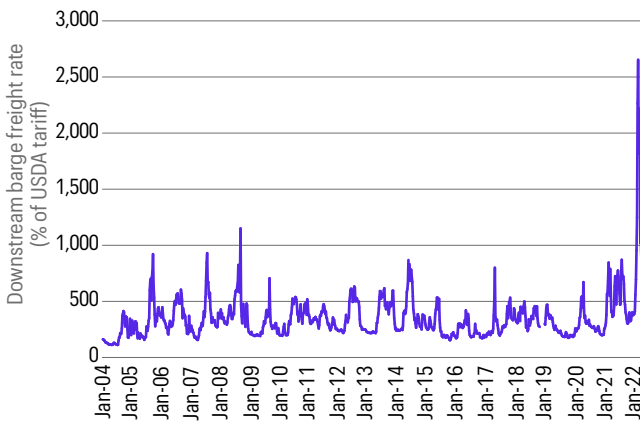


The Western U.S.’s drought has spread all the way to the Mississippi River.

The Mississippi River basin is by far the most important transportation corridor in the U.S. for crops, fertilizers, and energy commodities. The basin accounts for 92% of the country’s agricultural exports and most of its livestock. Sixty percent of all grain exported from the U.S. is shipped on the Mississippi River through the Port of New Orleans and the Port of South Louisiana.

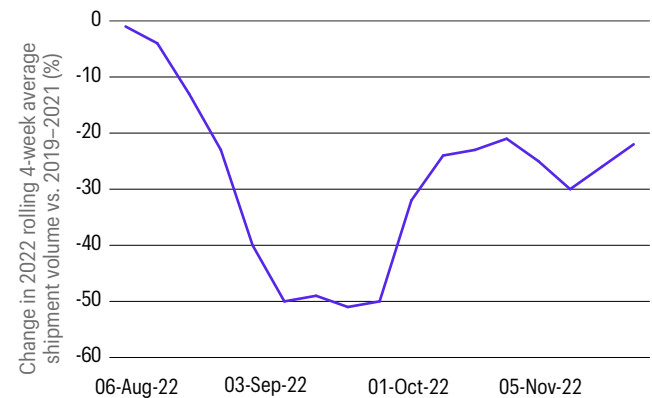
It’s therefore unsurprising that in October 2022, when drought drove the Mississippi River’s water levels so low that barge traffic had to cease on portions of the river, markets reacted dramatically. As the chart on the left below shows, barge rates spiked to a multiple of normal levels in the fourth quarter of 2022. In terms of economic impact, the drought’s effects on crop growth were even more consequential—the chart on the right shows the huge drop in grain shipments that resulted.

DROUGHT-INDUCED CONGESTION ON THE MISSISSIPPI DROVE EXTREME SPIKES IN BARGE FREIGHT RATES IN Q4 2022



Sources: Allspring and USDA; note downstream barge freight rates are quoted as a percent of USDA tariff

DROUGHT CONTRIBUTED TO A COLLAPSE IN 2022 U.S. GRAIN SHIPMENTS



Sources: Allspring and USDA

These extreme conditions developed at an inopportune time: It was the peak of the U.S. harvest, when barges heading downriver normally are busy carrying about 60% of U.S. grain exports to the world. Further upstream, barges transport petrochemicals, fertilizers, and raw materials essential to U.S. industry and agriculture. If barge traffic slows for an extended period, negative economic consequences are tangible and global. Logistical disruptions like these are among the many types of precipitation-driven costs. Another one—reduced crop yield—is also costly.

What’s more, falling river levels allow salt water from the Gulf of Mexico to intrude inland, harming agriculture and cities that depend on Mississippi River flows for their water supply. All considered, hundreds of millions of dollars for infrastructure upgrades to manage these problems may need to be spent soon.



Europe’s 2022 drought affected crops, energy production, and major arteries like the Rhine River.

Europe experienced a very dry, hot summer in 2022 and its worst drought in 500 years. Wildfires ravaged parts of Western Europe in July, and droughts led to water scarcity, compromising agriculture, power production, and many other industries. The impacts of the war in Ukraine, a world recovering from the COVID-19 pandemic, and low rainfall drove strong inflationary pressure on food and energy prices in Europe and beyond.

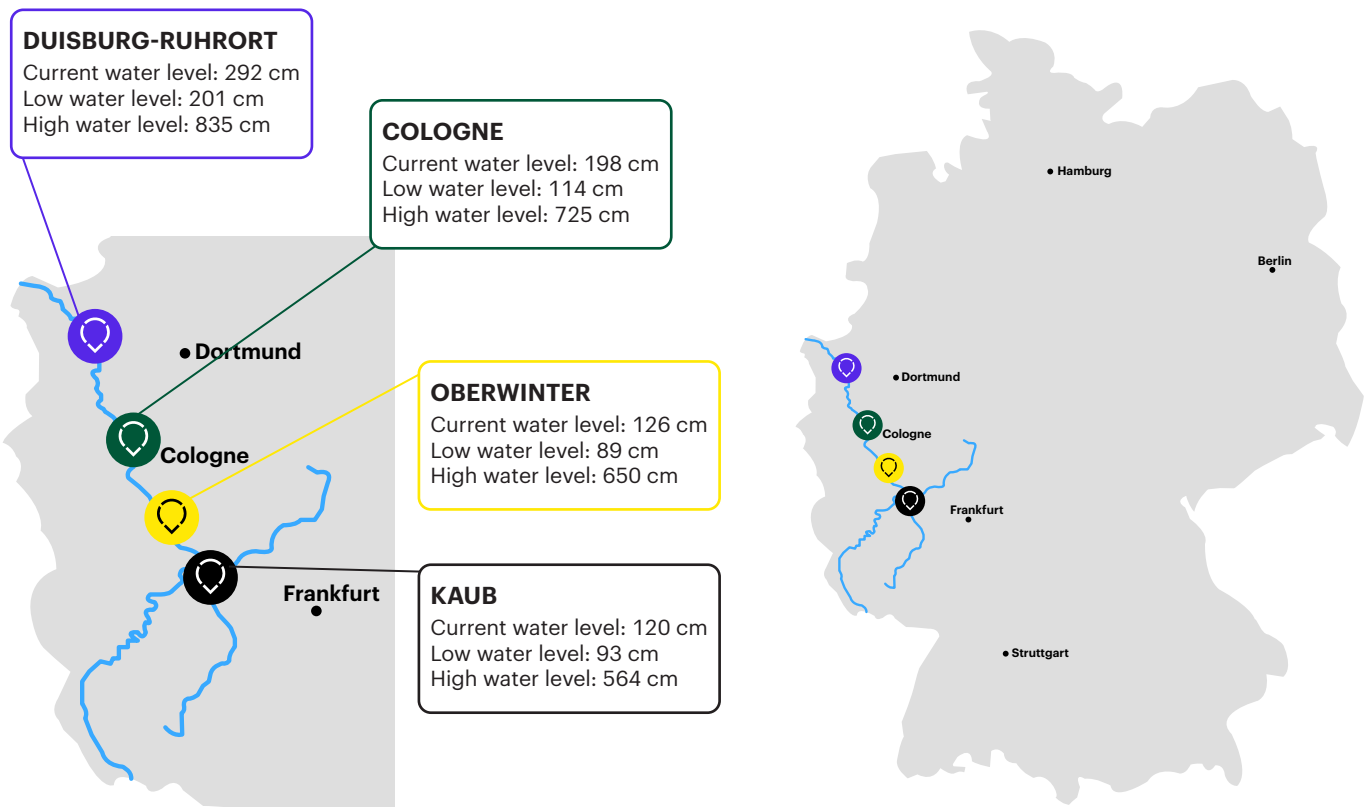
Crop yields in France, Romania, Spain, Portugal, and Italy suffered. In the Po River basin in Northern Italy, the rice harvest declined by 30%. Water rationing went into effect across Europe, from big cities like Paris to small villages in Southern Romania. In France, the drinking water for more than 100 towns had to be delivered by truck.

Flowing from the Swiss Alps to the North Sea, the Rhine River is a major route for transporting chemicals, grains,

and coal. During recent droughts (including 2022’s), low water levels reduced barge capacity to 30% to 40% of normal. Alternatives to river transportation involve roads and rail, which are more expensive and emit more carbon into the atmosphere.

High temperatures combined with low water levels continue to affect various areas of Europe’s economy. Power plants depend on cool river water, and in France, warmer river water reduced nuclear power-generation capacity during the summer months. Hydropower generation also has dropped: A leading electricity producer in Romania, Hidroelectrica, produced one-third less electricity in the first half of 2022, and in Spain, hydropower fell by 44% over the same period. As a result, energy prices have climbed for Europe’s consumers and businesses.

RHINE RIVER DEPTHS NEAR HISTORICAL LOWS, RESTRICTING BARGE TRAFFIC



Sources: Allspring and the hydrological information system (PEGELONLINE) of the Federal Waterways and Shipping Administration of Germany. Each bubble on the map represents a gauging station where the data provided was collected. Current water levels shown are as of 12-Sep-22.



Our research confirms that active assessment is needed now.

We've summarized below the key takeaways from our latest research on the agri-food value chain.

Warmer temperatures increase volatility in weather conditions, not just drought.

- Extreme weather events in recent years made clear that high levels of precipitation, hurricanes, and related flooding are more frequently and severely disrupting markets in Europe and the U.S.

Precipitation volatility, which leads to droughts and floods, affects agri-food production in two main ways.

- Importantly and unsurprisingly, precipitation levels affect crop production. As the distribution of weather events becomes more dispersed and asymmetric, so will agricultural output. Further, supply deficits of grain will be more likely than surpluses. In addition to agricultural commodity cost inflation, fertilizer and transportation costs may rise during rainfall deficits, further pressuring costs across the supply chain.

Climate change's physical effects will become more severe, especially if unaddressed.

- We believe the distribution of weather events—and therefore agricultural output—will become more dispersed and asymmetric. Grain supply deficits will be more likely than surpluses.
- Grain and fertilizer commodity and transportation price inflation will rise during deficits, increasing input costs for food producers.

A number of dynamics may reinforce and magnify other long-term, secular drivers of volatility and inflation.

- The demand for food will likely climb sharply, especially in emerging markets.
- Increasing wealth in emerging markets is changing consumer preferences and driving greater demand for animal protein. This will require more grain for feed, partially offset by a growing shift away from beef (cattle are relatively inefficient converters of plant protein to animal protein) to whiter meats and fish, which are more efficient converters.

- Unfarmed arable land will likely continue declining as population and new food demand force new acreage into production. This will make yield improvements the primary lever to increase supply.
- Food crops will increasingly compete with energy crops for arable land. Biofuels and renewable diesel production are set to increase sharply from already-high levels. For example, 40% of U.S. corn production today is used to produce fuel. About one-third of U.S. soybean production goes toward producing biodiesel.
- Geopolitical tensions appear likely to rise in tandem with income inequality. Government-imposed import and export restrictions, like those occurring now in Eastern Europe, could happen more often.

Several forces may help mitigate the severity of these effects.

- The world's agricultural supply base has become more diversified and flexible. Brazil, for example, is a key producer to meet growing demand.
- Global logistics chains have become more flexible. Rail and trucking alternatives to shipping have proliferated, as has the ability of large ports, like New Orleans', to import from many sources.
- Basic market forces can help mitigate the price effects. Higher prices should stimulate more production capacity through industrial and agricultural technology innovations that can drive growth in productive acreage and crop yields. In locations where consumers are supportive, genetically modified crops can provide new food solutions. Separately, big data and analytics are already driving higher crop yields. If high commodity prices persist, there will likely be even more investment in research and development to improve agronomic outcomes.





Allspring is responding.

Allspring employs two interactive systems to position investments for addressing climate change:

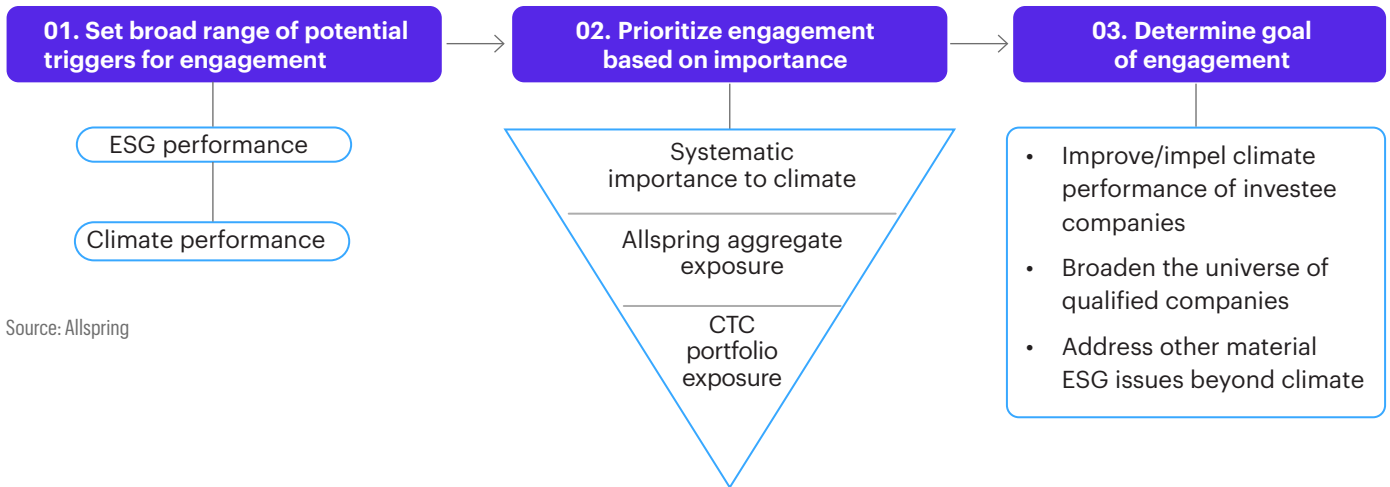
- 01 From a top-down perspective:** Our Water Working Group (WWG) and Climate Change Working Group (CCWG) run cross-industry analyses to assess risks and opportunities related to climate risk mitigation (decarbonizing within industries) and adaptation (expanding port and river infrastructures). These analyses maintain a disciplined emphasis on long-term fundamental trends (rather than focusing solely on next year’s earnings).
- 02 From a bottom-up perspective:** Our industry analysts apply robust analytical frameworks globally to better incorporate sustainability factors into their analyses of individual companies in each industry.

Our CCWG, WWG, industry analysts, and investment teams across the platform collaborate daily to ensure these analyses are integrated as appropriate into the investment teams’ decision-making processes for achieving clients’ goals.

Beyond investment research, Allspring engages through our Stewardship and Engagement team with companies in which we’ve invested. This is an essential active management tool to maximize the long-term value of our clients’ capital while influencing corporate behavior around decarbonization, water/agri-food/energy management, and other sustainability initiatives. These engagements deepen our understanding of companies’ operations and priorities. They also provide a platform to influence companies on material issues, like water management.

As an example, engagement is a fundamental pillar of our Climate Transition Credit strategy. We’ve identified and prioritized triggers for Climate Transition Credit engagement based on importance and have noted deliberate engagement outcomes, as shown below.

CLIMATE TRANSITION CREDIT (CTC) STRATEGY: PRIORITIZING ENGAGEMENT CANDIDATES



Source: Allspring

Here’s our bottom line.

It’s clear to us that the world is changing and physical consequences aren’t confined to the distant future—they’re affecting us now.

We believe substantial investment is needed to decarbonize industries, prepare for population growth, and fortify communities’ infrastructure worldwide. Allspring is committed to rigorously analyzing all aspects of sustainable investment risks and to actively seeking to uncover purposeful investing opportunities that may financially benefit our clients as well as more effectively manage the influence of affiliated risks.



For further information

We want to help clients build for successful outcomes, defend portfolios against uncertainty, and create long-term financial well-being. To learn more, investment professionals can contact us.

Contact details

FOR U.S. INVESTORS ONLY

- To reach our U.S.-based investment professionals, contact your existing client relations director, or contact us at **AllspringInstitutional@allspringglobal.com**.
- To reach our U.S.-based intermediary sales professionals, contact your dedicated regional director, or call us at **1-888-877-9275**.
- To reach our U.S.-based retirement professionals, contact Nathaniel Miles, head of Retirement at Allspring Global Investments, at **nathaniel.s.miles@allspringglobal.com**.
- To discuss sustainable investing solutions, contact Henrietta Pacquement, head of Sustainability, and Jamie Newton, deputy head of Sustainability at **henrietta.pacquement@allspringglobal.com** and **jamie.newton@allspringglobal.com**.

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