Stockholm Environment Institute

Climate risks to trade and food security: implications for policy

SEI policy brief

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Key messages

- **Transboundary climate risks to global food security are critical and mounting but, until now, have been largely unrecognized by the global community. Our assessment reveals how these risks are distributed via international trade in six key commodities, linking producers and consumers thousands of kilometres apart.**
- **Traditional approaches to managing trade risk, such as substitution and diversification, will be ineffective in a world that is facing accelerating climate change impacts simultaneously.**
- **There is high potential for increasingly tense geopolitical dynamics as countries – particularly large agricultural producers – reckon with their own vulnerability to climate change and strive to maintain their current market shares.**
- **A cooperative multilateral approach is required to assess, manage, and reduce these risks; responses that only account for national self-interest could undermine global resilience and exacerbate the global adaptation challenge.**
- **A global systemic view is essential for planning and implementing fair and effective adaptation. Achieving systemic resilience requires a level of international cooperation that is currently missing from global adaptation efforts. International organizations must do more to orchestrate and coordinate adaptation.**
- **The clear risks to food security in all countries – but especially in low income, import-dependent countries – makes adaptation to transboundary climate risk a matter of public policy. Public and private adaptation strategies need to be better aligned to achieve a just transition to a more resilient world.**

Introduction

This policy brief is based on the report *Climate Change, Trade, and Global Food Security*. The report provides a first systematic, quantitative assessment of transboundary climate risks to trade in six key agricultural commodities: maize, rice, wheat, soy, sugar cane, and coffee. The assessment is global in scope and allows for comparison of significant trading relationships, exporters, importers, and markets, providing a basis for policymaking and setting priorities in risk management.

IMAGE (ABOVE): © ARON YIGIN / UNSPLASH

Transboundary climate risks via trade are critical and mounting. They have remained largely unaddressed by the global community due to the national focus of most adaptation research and practice – obscured behind a veil of trade statistics. This report invites public- and private -sector actors into a new discussion about meeting the global adaptation challenge in ways that enable all people to share in the benefits of systemic resilience.

Agriculture is one of the most exposed sectors to climate change over both the short-term, as extreme weather events increase in frequency and severity, and the long-term, due to broader shifts in climatic patterns, especially temperature and precipitation. Not only does climate risk affect farmers whose livelihoods depend on crop yields, but also the complex network of actors who then depend on those agricultural products for food security or as inputs to other economic activities. Food security around the world depends on trade in staple foods, and that the risks to this trade will only increase as the impacts of climate change become more evident.

Methodology

This report develops a novel methodology for assessing climate risks to global trade in agricultural commodities. The analysis projects the extent to which the impacts of climate change will affect yields of major agricultural commodities in particular countries over time, combined with a measurement of trade dependencies for specific commodities.

The assessment rests on a "stress test" approach that is described in full detail in the report. However, it is important to note that, owing to methodological constraints, the assessment measures only long-term trends in agricultural production due to climate change and does not assess the impact of extreme weather events, or risks to infrastructure such as storage facilities or transportation. Overall, this means that results presented are in several critical ways a conservative assessment of climate risks to future food production and trade.

Climate risks to global trade in key commodities

Climate change will dramatically impact agricultural production all around the globe. In some cases, warmer temperatures will reduce yields, while in some limited circumstances agricultural productivity may increase. Overall, this assessment suggests that the risks are many times greater than the opportunities.

This assessment projects a global yield reduction resulting from climate change across five of the six commodities considered:

Maize	-27.0%
Rice	-8.1%
Wheat	+13.9%
Soy	-7.2%
Sugar cane	-58.5%
Arabica coffee	-45.2%
Robusta	-23.5%

Maize, rice and wheat play a critical role in global food security, and this report underscores that climate change not only creates risks for producing countries, but also for consumers of all kinds, often at significant distances from a commodity's point of origin.

For staple commodities, maize and rice markets are highly exposed to climate change. Wheat production appears more stable as a whole but may require redistribution to Europe and parts of South America and Asia at significant cost and with negative consequences for existing producers.

Our results indicate that climate risks to global food security are disproportionately transmitted from a small number of countries: Brazil, China and the US for exports of maize; Thailand and the US for exports of rice; and the US again for wheat. Highly embedded commodities, like soy and sugar cane, pose an indirect risk to food security in all consumer countries by threatening to drive price increases and shocks across a basket of products.

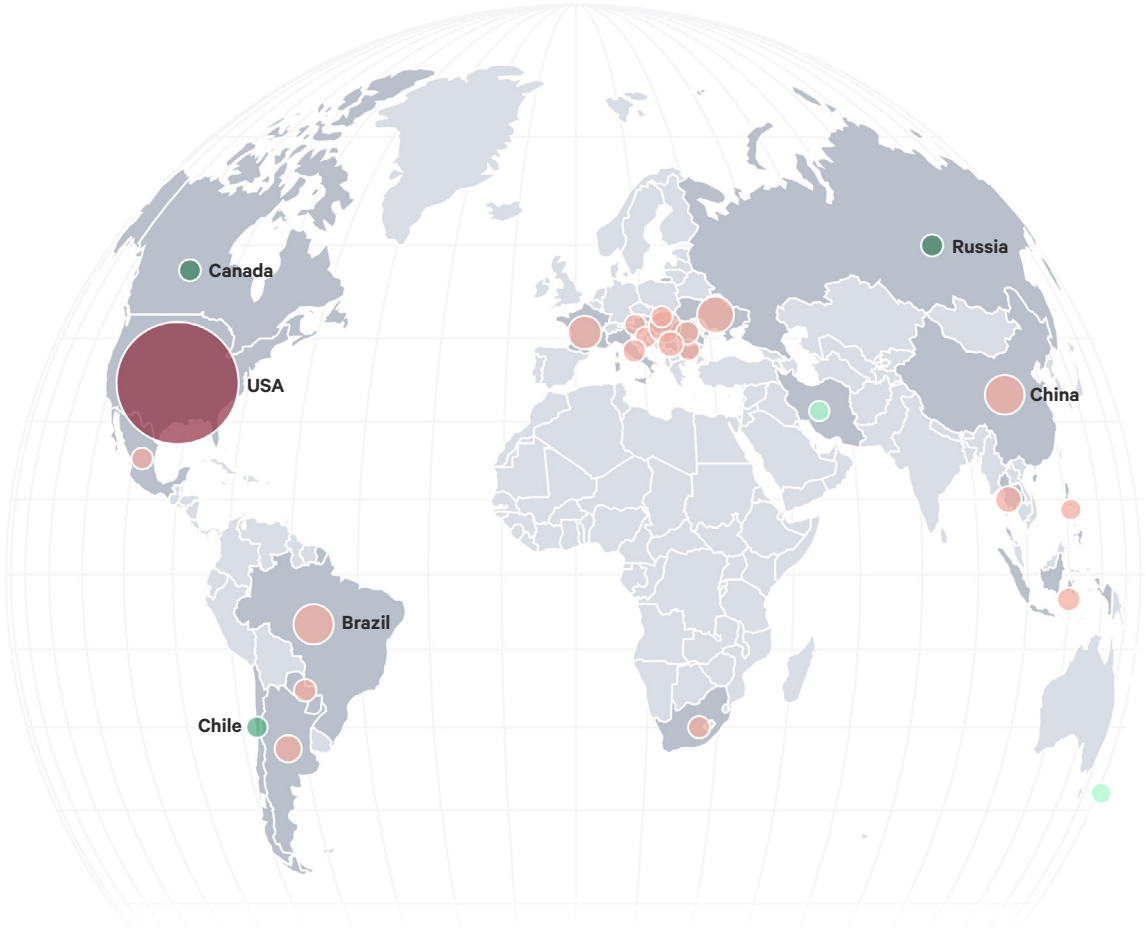
These challenges have profound implications for markets, countries, and firms around the world.

These challenges have profound implications for markets, countries, and firms around the world. For example, in the maize market, climate change could lead to a 45.5% reduction in US production. Such an outcome would likely drive-up maize prices worldwide, adversely impacting US producers and the American economy, in addition to consumers in Jamaica, Costa Rica and Japan, who are highly dependent on US-grown maize.

Notable spatial patterns also emerge from the results. Countries like Kenya and Bolivia are exposed to high climate risks from within their regions. Latin America and the Caribbean are highly dependent on risky imports from the US. Regional patterns persist, but are less prominent, for highly globalized countries like the UK, Germany and Singapore.

The trade links that transmit transboundary climate risk are not random: they reflect historical, regional and geopolitical ties between countries. Adaptation to reduce these risks will be facilitated and constrained by these same geopolitical factors. For example, Singapore's management of high climate-risk trade dependencies on China, the US and Brazil cannot be seen in isolation from its other commercial, political and strategic relationships with those countries.

Top global exporters of risk for **maize**



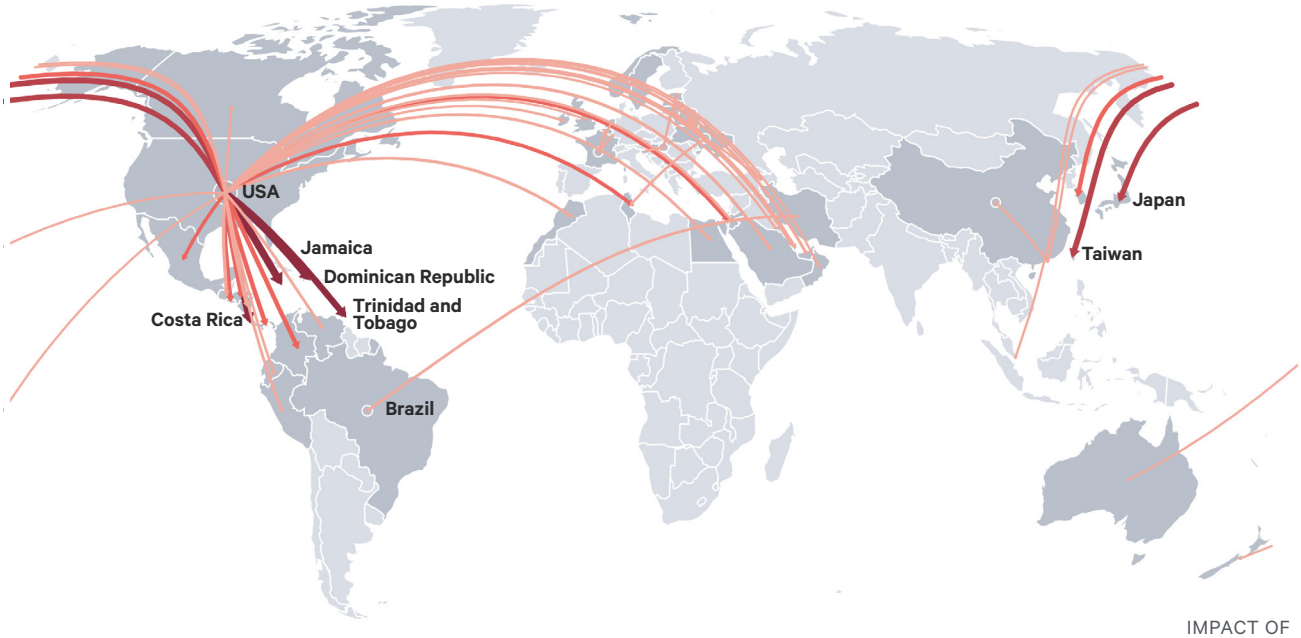
43:1 RISK TO OPPORTUNITY RATIO

226.2 MN TONNES TOTAL GLOBAL FLOW

-27.2% IMPACT OF CLIMATE CHANGE ON PRODUCTION

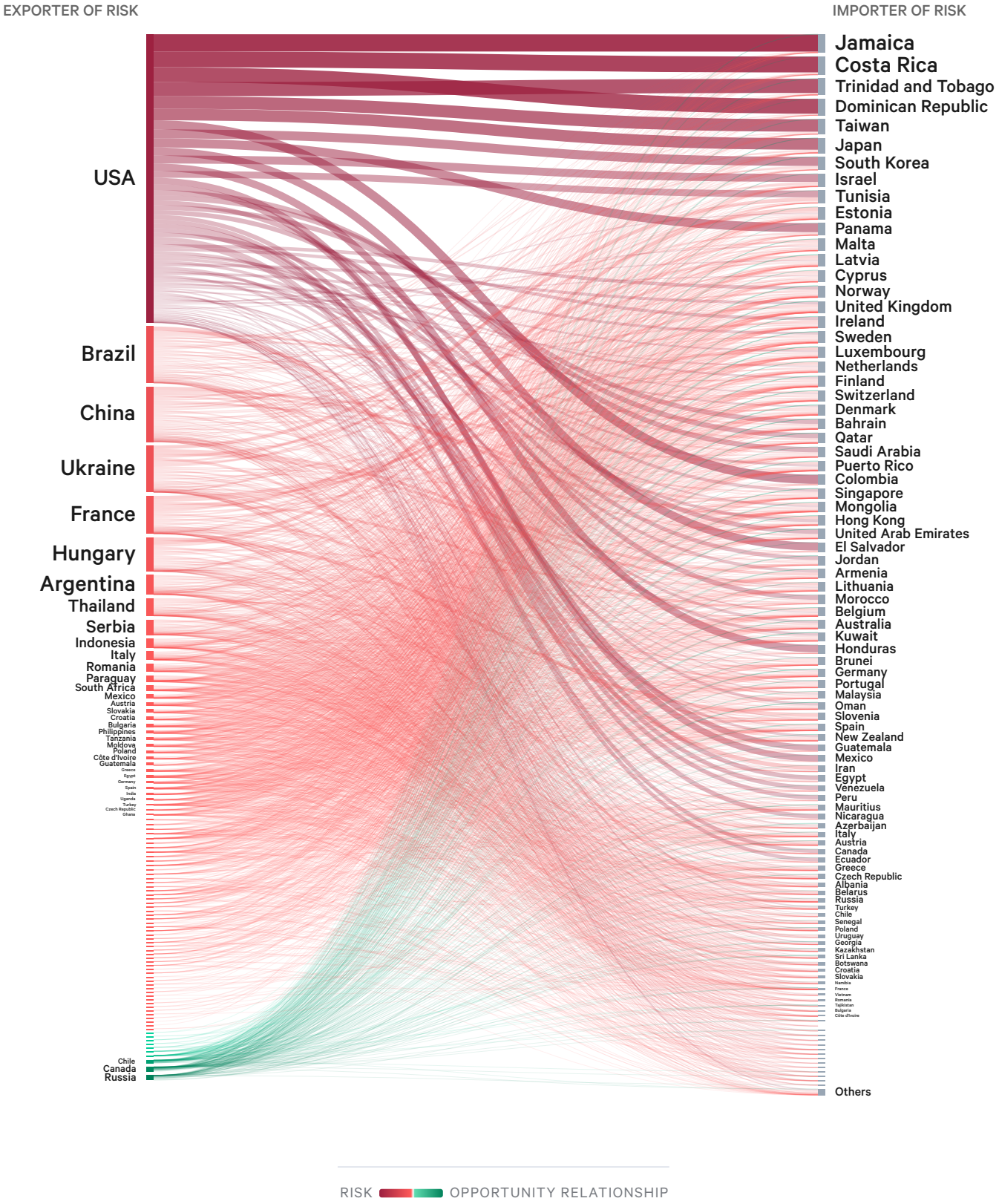
#	EXPORTER	TOTAL SHARE OF GLOBAL RISK (%)	EMBEDDED EXPORTS (TONNES)	IMPACT OF CLIMATE CHANGE ON PRODUCTION
1	USA		64.18mn	-45.5%
2	Brazil		20.33mn	-22.1%
3	China		32.81mn	-15.5%
4	Ukraine		9.66mn	-29.5%
5	France		8.25mn	-32.2%
6	Hungary		4.55mn	-45.0%
7	Argentina		18.04mn	-6.8%
8	Thailand		3.14mn	-48.7%
9	Serbia		6.11mn	-41.4%
10	Indonesia		3.47mn	-21.0%
11	Italy		1.61mn	-32.1%
12	Romania		1.97mn	-34.3%
13	Paraguay		1.85mn	-24.5%
14	South Africa		2.36mn	-8.7%
15	Mexico		1.88mn	-35.6%
16	Austria		0.99mn	-29.2%
17	Slovakia		0.53mn	-39.9%
18	Croatia		0.34mn	-40.3%
19	Bulgaria		1.08mn	-17.9%
20	Philippines		1.26mn	-25.3%
...	...		...	...
5	Iran		0.10mn	23.5%
4	New Zealand		0.14mn	69.7%
3	Chile		0.52mn	67.1%
2	Canada		4.49mn	17.0%
1	Russia		1.58mn	12.7%

Top 50 high-risk bilateral trade relationships for **maize**

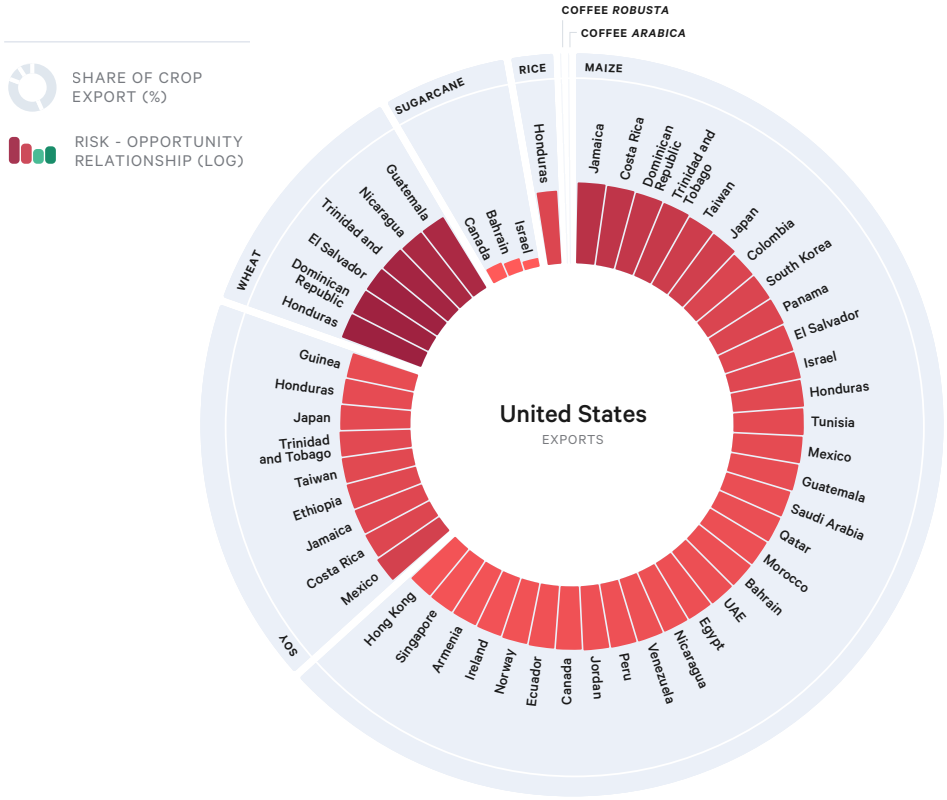


#	EXPORTER	IMPORTER	RISK TO BILATERAL TRADE	EMBEDDED TRADE FLOW (TONNES)	IMPORTER'S TOTAL STOCK	IMPACT OF CLIMATE CHANGE ON PRODUCTION
1	USA	Jamaica		0.28mn	0.32mn	-45.5%
2	USA	Costa Rica		0.42mn	0.53mn	-45.5%
3	USA	Dominican Republic		0.83mn	1.13mn	-45.5%
4	USA	Trinidad and Tobago		0.09mn	0.13mn	-45.5%
5	USA	Taiwan		2.85mn	4.62mn	-45.5%
6	USA	Japan		16.99mn	29.64mn	-45.5%
7	USA	Colombia		2.19mn	4.84mn	-45.5%
8	USA	Republic of Korea		4.99mn	11.13mn	-45.5%
9	USA	Panama		0.30mn	0.66mn	-45.5%
10	USA	El Salvador		0.59mn	1.49mn	-45.5%
11	USA	Israel		0.72mn	1.81mn	-45.5%
12	USA	Honduras		0.37mn	1.00mn	-45.5%
13	USA	Tunisia		0.26mn	0.78mn	-45.5%
14	USA	Mexico		10.49mn	33.29mn	-45.5%
15	USA	Guatemala		0.71mn	2.44mn	-45.5%
...	...		...	...	...	...
25	Brazil	Iran		2.48mn	5.67mn	-22.1%
26	USA	Jordan		0.13mn	0.62mn	-45.5%
27	USA	Canada		2.98mn	15.68mn	-45.5%
28	USA	Ecuador		0.30mn	1.65mn	-45.5%
29	Hungary	Slovenia		0.11mn	0.62mn	-45.0%
30	Hungary	Estonia		0.02mn	0.09mn	-45.0%
...	...	...	...	...	...	...
45	USA	Australia		0.26mn	1.85mn	-45.5%
46	USA	Sweden		0.09mn	0.64mn	-45.5%
47	Ukraine	Belarus		0.19mn	0.88mn	-29.5%
48	USA	New Zealand		0.07mn	0.55mn	-45.5%
49	France	Netherlands		0.71mn	3.80mn	-32.2%
50	France	Belgium		0.58mn	3.16mn	-32.2%

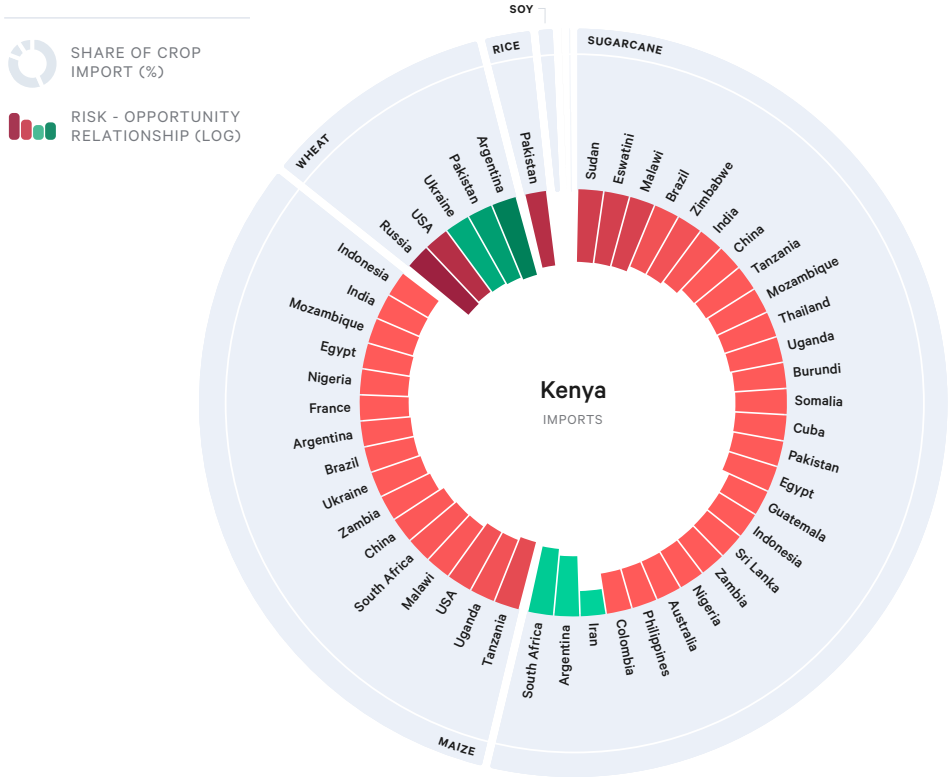
Risk and opportunity in bilateral trade relationships for **maize**



Key trade relationships and climate risk for US exports



Key trade relationships and climate risk for Kenyan imports



Implications

The findings of this report underscore the systemic nature of climate risk to agricultural commodity trade and global food security. Unlike other challenges experienced in international trade, climate change risk is present everywhere, simultaneously. Climate change will increase the risk of compound events, potentially affecting multiple major breadbasket regions in the same season. Even under nearer term scenarios, the stress put on agricultural commodity trade by variable and generally decreasing yields due to climate change is likely to heighten volatility and threaten the stability of commodity markets.

The high likelihood of negative impacts on commodity production worldwide radically reduces the space in which actors will be able to diversify, substitute and hedge agricultural commodity trade risks.

The high likelihood of negative impacts on commodity production worldwide radically reduces the space in which actors will be able to diversify, substitute and hedge agricultural commodity trade risks. For most countries, the orthodox supply chain management logic of replacing high-risk suppliers with more resilient ones is unlikely to be a plausible strategy in a competitive world facing systemic risks from a changing climate.

Awareness alone is unlikely to lead to the needed adaptation that will deliver systemic resilience. In fact, awareness of TCRs in global food trade, to which this assessment contributes, might encourage actors to pursue a course of narrow self-interest that does more to exacerbate systemic risk than reduce it.

A retreat from global integration and a return to protectionism and regionalization could destabilize markets further, likely to the detriment of those countries who can least afford to compete in such a world. These include those that have been heavily incentivized in recent decades to open up to global markets as a solution to the challenge of achieving food security. Not only would this represent a major injustice, but it would also not be in any country's long-term interest to undermine systemic resilience in this way.

However, the same results can support a different conclusion: international trade helps all countries to diffuse the risk from climate change. Free and open access to international markets will help all participants to meet the daunting challenge of achieving food security in a world challenged by climate change, population growth and shifting diets. Markets are mechanisms of interdependence; the deep reach of agricultural commodity markets, into and across countries at all levels of development and in all continents, reminds us that global resilience is a function of the resilience of all countries, including those with the least ability to invest in resilience themselves. It reiterates the importance of ensuring successful adaptation at all scales and in all places and articulates clearly the shared benefits of investing boldly in adaptation.

We do not yet know what a "climate resilient" trade profile looks like. We do not know what balance of domestic production and access to international markets, or how many or which types of trade partners, will offer the most resilience against uncertain but systemic risks in the global agricultural commodity trade. What we do know is that there is a pressing need for multilateral cooperation to address these risks and develop effective, coordinated responses.

Policy considerations

Effective and just adaptation action is vital, particularly in key exporting countries

This places responsibility on producer countries to consider the wider systemic effects of domestic adaptation actions. It also underscores the need for international value chain actors and their investors to ensure that private-sector adaptation contributes to achieving "just resilience" at both local and global scales. Further, it places responsibility on the international community to provide the necessary political, legal, institutional, financial and logistical support for adaptation in countries that lack capacity, and to build robust structures for international cooperation to jointly address these shared, systemic risks.

Prioritizing global cooperation on adaptation, and mechanisms to achieve it

Whereas climate change adaptation has traditionally been pursued as a nationally driven or even local process, our results invite decision makers to rethink the value of global cooperation on adaptation. Fortunately, there are mechanisms that can help countries build systemic resilience to climate change, principally via the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. In particular, Article 7 of the Paris Agreement establishes the Global Goal on Adaptation (GGA) to enhance adaptive capacity and resilience and reduce vulnerability. It also frames adaptation as a "global challenge", recognizing its "regional and international dimensions." There is ample space in this context to include the important transboundary elements of climate risk.

Giving serious consideration to TCRs would necessitate that Parties to the UNFCCC, many of whom may view adaptation as a secondary or even marginal concern in the negotiations, re-consider the value of a truly global approach to adaptation.

Rethinking climate finance for adaptation

This report reveals that all countries have a shared interest in building climate resilience: importers benefit when exporters can adapt to the impacts of climate change and sustain their agricultural production. Therefore, importers will want to see – and consider what they can do to facilitate – successful adaptation in other countries, particularly those with which they trade. This raises new questions about how international climate finance for adaptation is targeted. In addition to providing finance to single countries, important global or international systems – such as the global maize market – can be identified and adaptation finance contributed toward building resilience in that system, to the benefit of all who participate in it.

Who is responsible for adapting to climate risks to food trade?

This report provides a basis from which to ask challenging questions about the governance of climate change risk in an interconnected world. For example, which government agencies should "own" responsibility for adapting to transboundary climate risk? And what is the appropriate division of labour between the state and private enterprises in managing trade-related climate risk? It should also spark needed policy debate about how the international community will rise to meet this emerging challenge, which includes:

- how the UNFCCC intends to advance the Global Goal on Adaptation, particularly in view of the Global Stocktake
- how the WTO will meaningfully incorporate elements of climate change and sustainability into its work, and
- how countries will conduct diplomacy in a context where multilateralism and global cooperation remain under threat, but climate action is high on the political agenda.

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