FOOD SECURITY

International trade is a key component of climate change adaptation

Trade liberalization in the early 21st century increased the adaptation capacity of global food systems to climate change; further liberalization and trade facilitation could help to avoid dozens of millions being undernourished at mid-century. The global trade agenda should explicitly include climate change adaptation to achieve SDG 2 Zero Hunger.

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The policy problem

Climate change is expected to reduce crop yields and increase food prices globally, which will threaten the achievement of UN Sustainable Development Goal 2 to end global hunger. Yet there are regional differences in climate change impacts, and international trade can be an important adaptation mechanism by connecting regions of food deficit with those of food surplus. Even though climate and trade policy agendas have started to converge, the extent to which future climate change impacts should be considered in the development of international trade policies remains unclear. Trade barriers such as import tariffs, export restrictions, limited infrastructure or inefficient customs procedures substantially limit agricultural trade flows and may affect the capacity of trade to mitigate climate change impacts. Climate change adaptation may therefore need to be addressed by the full spectrum of the global trade policy agenda, from agreements on free trade to rules on trade restrictions.

The findings

Under current trade barriers, a pessimistic scenario of high global warming (+4 °C by 2100) with no benefits from enhanced atmospheric CO₂ on crops could cause up to an additional 55 million people to be undernourished by 2050, mostly in Sub-Saharan Africa and South Asia. If trade restrictions that prevent increased trading under climate change were imposed, the impact could increase to an additional 73 million people. Reduction in tariffs and improvements in trade infrastructure would limit the impact to an additional 20 million people. For export-oriented regions, however, partial trade integration could lead to lower domestic food availability. The findings show that trade policies clearly influence the sensitivity of hunger to climate change. The study focuses on the impacts of trade and climate change on food availability and does not account for income effects, which determine people's access to food. Furthermore, it does not investigate extreme weather events such as droughts and floods, which are likely to accentuate the importance of trade for adaptation.

Messages for policy

- International trade can substantially contribute to climate change adaptation by reducing global hunger driven by the heightened pressure of climate change on agricultural markets.
- Tariffs and quantitative trade restrictions, which countries sometimes implement in response to crisis situations, tend to aggravate the increase in hunger caused by climate change.
- Lowering tariffs and infrastructure-related barriers mitigates impacts on hunger in import-oriented regions, although caution is needed to avoid food price increases in export-oriented regions.
- Opening to trade may further expose farmers in severely hit import-oriented regions, which calls for holistic development programs to redistribute benefits and compensate income losses.
- Trade agreements should better account for adaptation by preventing border restrictions, facilitating trade and identifying distribution consequences and safeguards in ex-ante impact assessments.

The study

The analysis builds on an integrated framework of climate, crop and economic simulation models that assesses the long-term impact of climatic and socio-economic changes on global hunger. We develop a baseline at which global hunger is reduced by 2050 following population and income growth and reduced inequalities,

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and compare this with scenarios that vary in projected climate outcomes (from 2 °C to 4 °C global warming) and trade barriers. The climate models estimate temperature and precipitation under alternative concentrations of greenhouse gas emissions, which the crop model translates into yield impacts. The yield changes are incorporated into the economic model at detailed spatial scale to accurately represent biophysical effects, and we model the interaction of these with changes in import tariffs and other international trade costs.

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Further reading

Nelson, G. C. et al. Climate change effects on agriculture: economic responses to biophysical shocks. *Proc. Natl Acad. Sci. USA* **111**, 3274–3279 (2014).

A seminal paper from the Agricultural Model Intercomparison and Improvement Project (AgMIP) that compares the impact of climate change on agricultural markets estimated by nine global economic models.

Brown, M. E. et al. Do markets and trade help or hurt the global food system adapt to climate change? *Food Policy* **68**, 154–159 (2017).

A position paper on the role of trade for food security under a changing climate, referring to the concept of double exposure.

Tigchelaar, M., Battisti, D. S., Naylor, R. L. & Ray, D. K. Future warming increases probability of globally synchronized maize production shocks. *Proc. Natl Acad. Sci. USA* **115**, 6644–6649 (2018).

An analysis of maize yield variability under future climate change in the main

producing and exporting countries, discussing the implications for food security through trade.

Trnka, M. et al. Mitigation efforts will not fully alleviate the increase in water scarcity occurrence probability in wheat-producing areas. *Sci. Adv.* **5**, eaau2406 (2019).

A study of the future probability of simultaneous droughts in the main wheat-producing regions, discussing the role of stocks, financial markets and trade policies in managing price spikes.

Gouel, C. & Laborde Debucquet, D. The crucial role of domestic and international market-mediated adaptation to climate change. *J. Environ. Econ. Manage.* **106**, 102408 (2021).

A quantitative modelling exercise on the welfare effects of climate change impacts at the end of the century and the adaptive roles of production and trade adjustments.

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Competing interests

The authors declare no competing interests.