"Food security: International trade is a key component of climate change adaptation"

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

The policy problem

Climate change is expected to reduce crop yields and increase food prices globally, thereby threatening the achievement of the 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 food deficit with food surplus regions. Even though climate and trade policy agendas have started to converge, it remains unclear to what extent future climate change impacts should be considered in the development of international trade policies. 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

require consideration across 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 CO_2 on crops could lead to up to an additional 55 million people undernourished by 2050, mostly in Sub-Saharan Africa and South Asia. If trade restrictions were imposed that prevent increased trading under climate change, 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 food availability impacts of trade and climate change and does not account for income effects, which determine people's access to food. It further does not investigate extreme weather events such as droughts and floods, which are likely to accentuate the role of trade for adaptation.

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 in which global hunger is reduced by 2050 following population and income growth and reduced inequalities, and compare this with scenarios that vary in projected climate outcomes (from a 2°C to a 4°C global warming) and trade barriers. The climate models provide temperature and precipitation under alternative concentrations of greenhouse gas emissions, which the crop model translates into yield impacts. The yield changes are incorporated in the economic model at detailed spatial scale to accurately represent biophysical effects, which we then interact with changes in import tariffs and other international trade costs.

Messages for Policy

- International trade can substantially contribute to climate change adaptation by reducing the global hunger impacts driven by heightened pressure of climate change on agricultural markets.
- Tariffs and quantitative trade restrictions, as countries sometimes implement in response to crisis situations, tend to aggravate hunger impacts from climate change.
- Lowering tariffs and infrastructure-related barriers mitigates hunger impacts in import-oriented regions, though 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, calling 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 distributional consequences and safeguards in ex-ante impact assessments.

Source research

Janssens, C., Havlík, P., Krisztin, T., Baker, J., Frank, S., Hasegawa, T., … Maertens, M. (2020). Global hunger and climate change adaptation through international trade. *Nature Climate Change*. https://doi.org/10.1038/s41558-020-0847-4

Further Reading

Nelson, G. C., Valin, H., Sands, R. D., Havlík, P., Ahammad, H., Deryng, D., … Willenbockel, D. (2014). Climate change effects on agriculture: Economic responses to biophysical shocks. Proceedings of the National Academy of Sciences, 111(9), 3274–3279. https://doi.org/10.1073/pnas.1222465110
A seminal paper from the Agricultural Model Intercomparison and Improvement Project (AgMIP) that compares the impact of climate change on agricultural markets from nine global economic models.

Brown, M. E., Carr, E. R., Grace, K. L., Wiebe, K., Funk, C. C., Attavanich, W., … Buja, L. (2017). Do markets and trade help or hurt the global food system adapt to climate change? Food Policy, 68, 154–159. https://doi.org/10.1016/j.foodpol.2017.02.004
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. (2018). Future warming increases probability of globally synchronized maize production shocks. Proceedings of the National Academy of Sciences of the United States of America, 115(26), 6644–6649. https://doi.org/10.1073/pnas.1718031115
An analysis of maize yield variability under future climate change in main producing and exporting countries, discussing the implications for food security through trade.

Trnka, M., Feng, S., Semenov, M. A., Olesen, J. E., Kersebaum, K. C., Rötter, R. P., … Büntgen, U. (2019). Mitigation efforts will not fully alleviate the increase in water scarcity occurrence probability in wheat-producing areas. Science Advances, 5(9), 1–12. https://doi.org/10.1126/sciadv.aau2406
A study of the future probability of simultaneous droughts in main wheat producing regions, discussing the role of stocks, financial markets and trade policies in managing price spikes.

Gouel, C., & Laborde, D. (2021). The crucial role of domestic and international market-mediated adaptation to climate change. Journal of Environmental Economics and Management, 106, 102408. https://doi.org/10.1016/j.jeem.2020.102408
A quantitative modelling exercise on the welfare effects of end-of-the-century climate change impacts, and the adaptive role of production and trade adjustments.

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Competing interests
The authors declare no competing interests.