Impacts of climate change on global food trade networks

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Background

Higher temperatures will significantly modify crop production

(Parry et al 2004, Wheeler and Braun 2013, Bezner Kerr et al 2022).

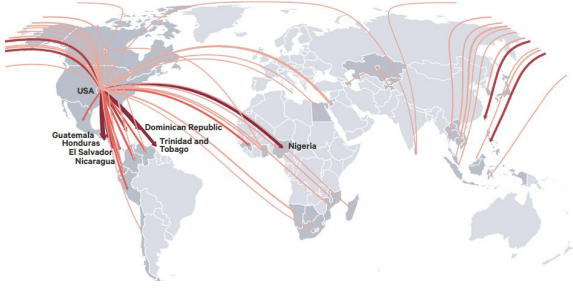
Acceleration in countries' dependence on overseas trade for food supply

(D'Odorico et al 2014, Janssens et al 2020)

Countries' reliance on global food trade networks implies that climate change impacts on crop yields will be transmitted across borders

(Adams et al., 2022)

Food trade networks – what are systemic effects?



Wheat

Rice

Maize

Adams et al., 2021

Research design

Research question

How may trade patterns between countries be disrupted and reoriented under potential long-term climate change impacts on food production?

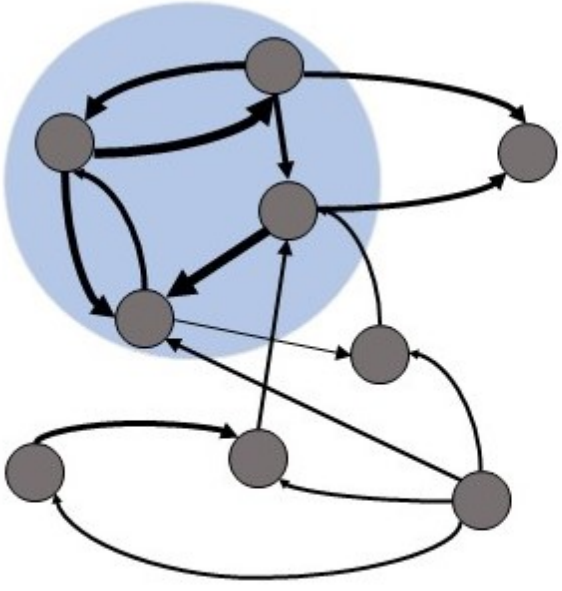
Data

- FAO production and bilateral trade data for wheat, rice and maize (corrected for re-exports)
- ISIMIP simulation phase 3b for climate impacts on crop production (five global climate models + five global gridded crop models) (RCP 8,5, 2070–2099)

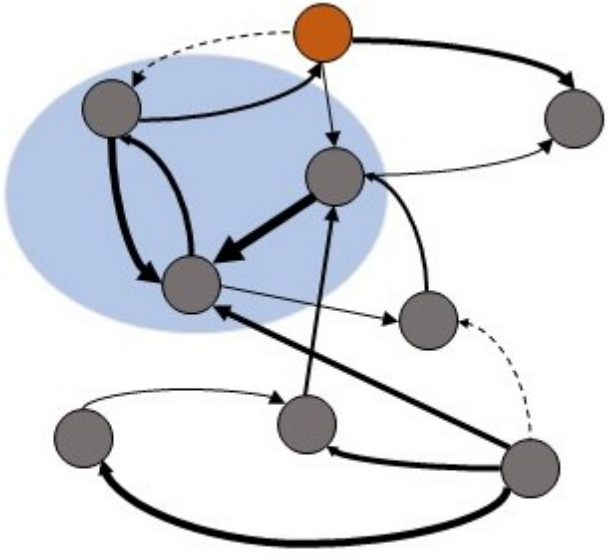
Methods

- Network modelling: community detection (network communities)
- Network modelling: functional cartography (network roles)
- Distribution of impacts on combined supply (domestic production + imports) within communities

Minimal model of trade networks

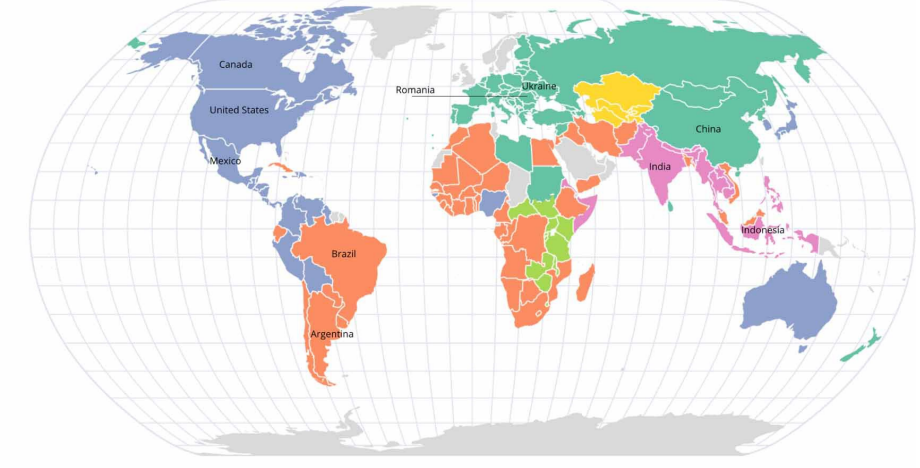


a) Present-day network

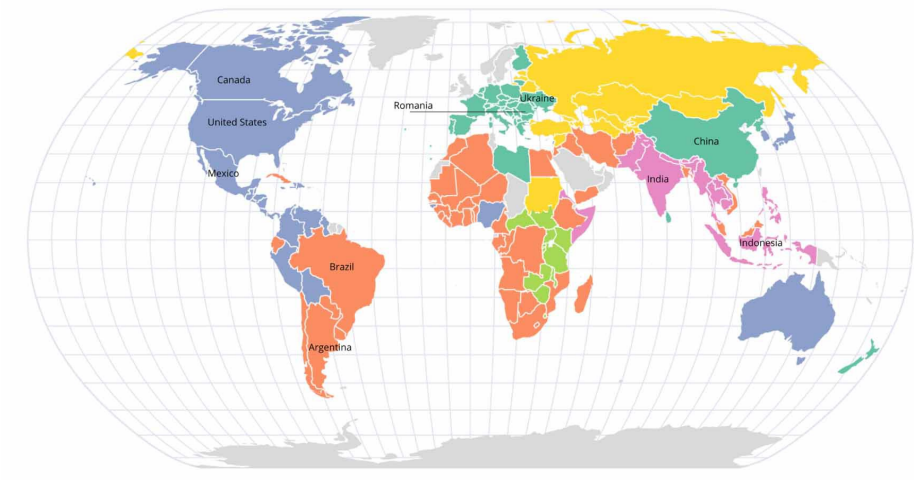


b) Climate-projected network

Reoriented trade communities

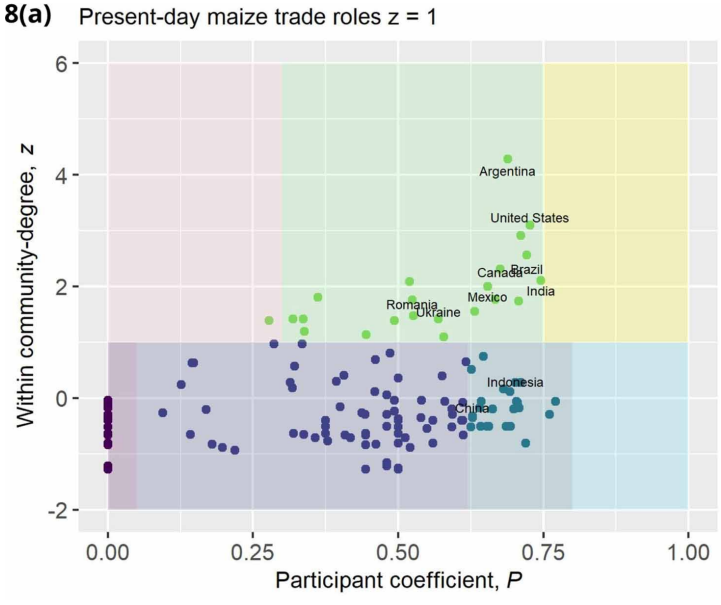


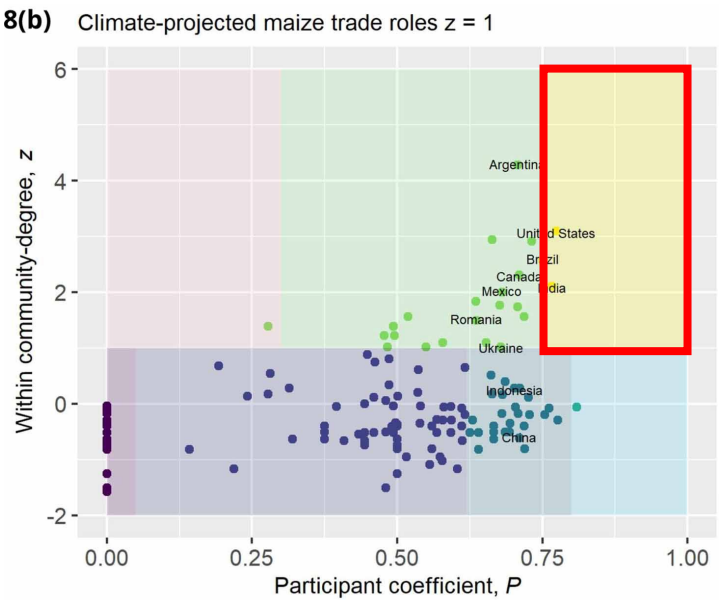
5(a) Maize trade communities in 2018



5(b) Climate-projected maize trade communities (2070-2099)

More distributed trade by large producers





Disruptions to combined supply

Table 1. (Continued.)

Maize	1	2	3	4	5	6
Trade community	Community production—present-day climate conditions (tonnes)	Community production as % of world production	Climate-projected community production (tonnes) and change compared to present-day	Total import (tonnes) and share of production—present-day climate conditions	Climate-projected total import (tonnes) and change compared to present-day	Total climate-induced change in production plus import
1	83 554 440	7%	64 155 333 (−23%)	2072 181 (3%)	1582 681 (−24%)	−23%
2	453 883 616	40%	340 857 118 (−25%)	61 495 385 (14%)	46 564 236 (−24%)	−25%
3	192 959 809	17%	163 405 845 (−15%)	47 328 308 (25%)	39 980 756 (−16%)	−15%
4	394 390 952	34%	330 618 348 (−16%)	40 392 955 (10%)	34 084 162 (−16%)	−16%
5	19 757 003	2%	19 364 669 (−2%)	824 322 (4%)	731 770 (−11%)	−2%
6	2245 491	<1%	1877 669 (−16%)	55 790 (3%)	45 698 (−18%)	−16%
TOTAL	1146 791 311	100.0%	920 278 982 (−20%)	152 168 941 (13%)	122 943 606 (−19%)	−20%

Conclusions

A country's future trade-linked climate exposure - a **combined effect** of domestic yield change and the balance of production loss or gain among trade partners

Few countries may be able to buffer production loss with imports from existing, close trade partners if maintaining current consumption levels, especially for maize

Trade as an adaptation mechanism may be **more viable for wheat and rice** than it is for maize

Cross-border climate impacts likely to have disruptions on **national and global food supply**

Hedlund J, H Carlsen et al, 2022: Impacts of climate change on global food trade networks. Environmental Research Letters, 7, 124040

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Thank You