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Food System Transformations & Biosecurity Threats

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Food System Transformations over time

- 1960-1980: The quest for hunger reduction & the dominance of staple cereal systems
- 1980-2000: Income growth & the rising demand for food diversity
- 2000-2020: Globalization of food trade & consumer tastes
- Beyond 2020: Food, environment & human health nexus

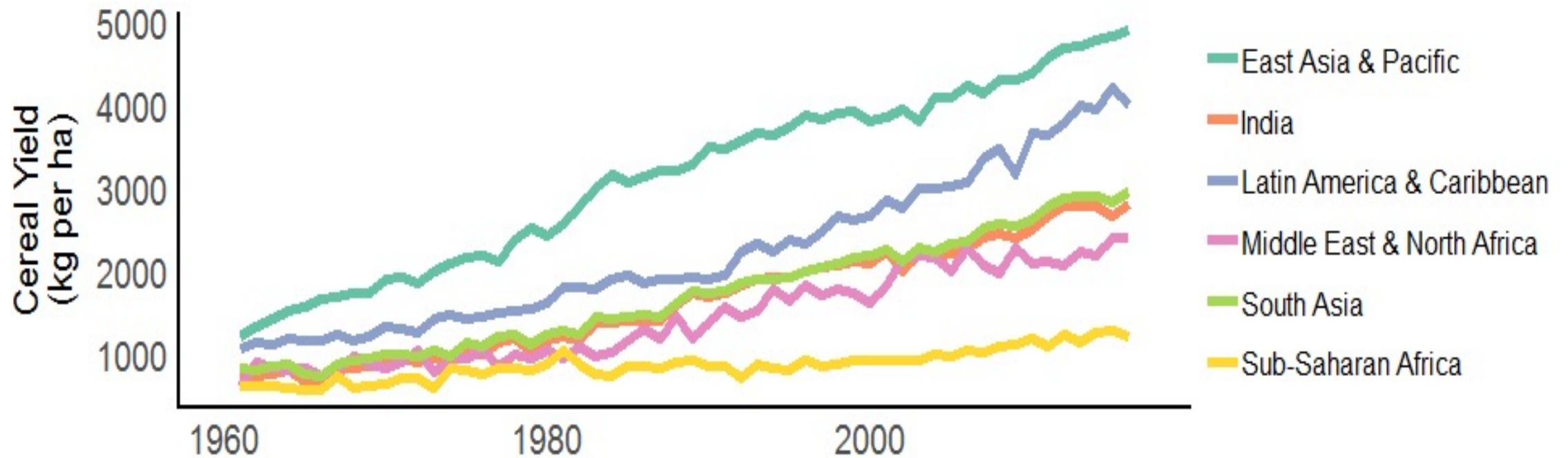


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Global Trends in Cereal Yields 1960 - 2016

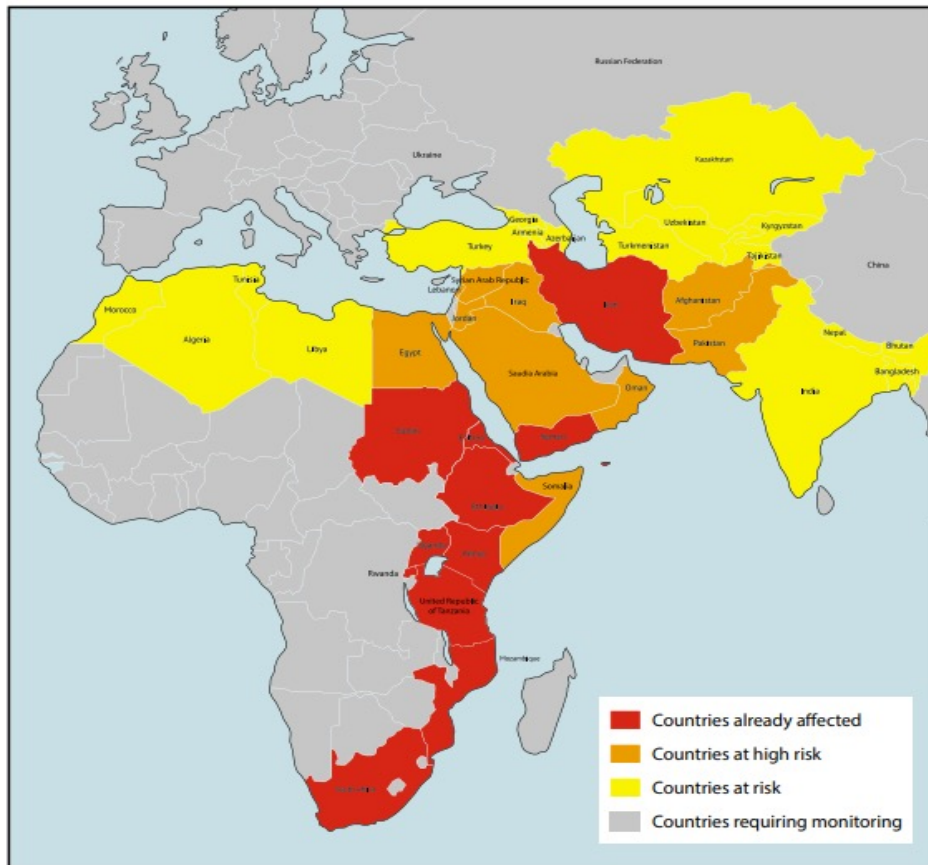


Regional trends in cereal yields, 1961 - 2016. (Data source: WDI, 2018).

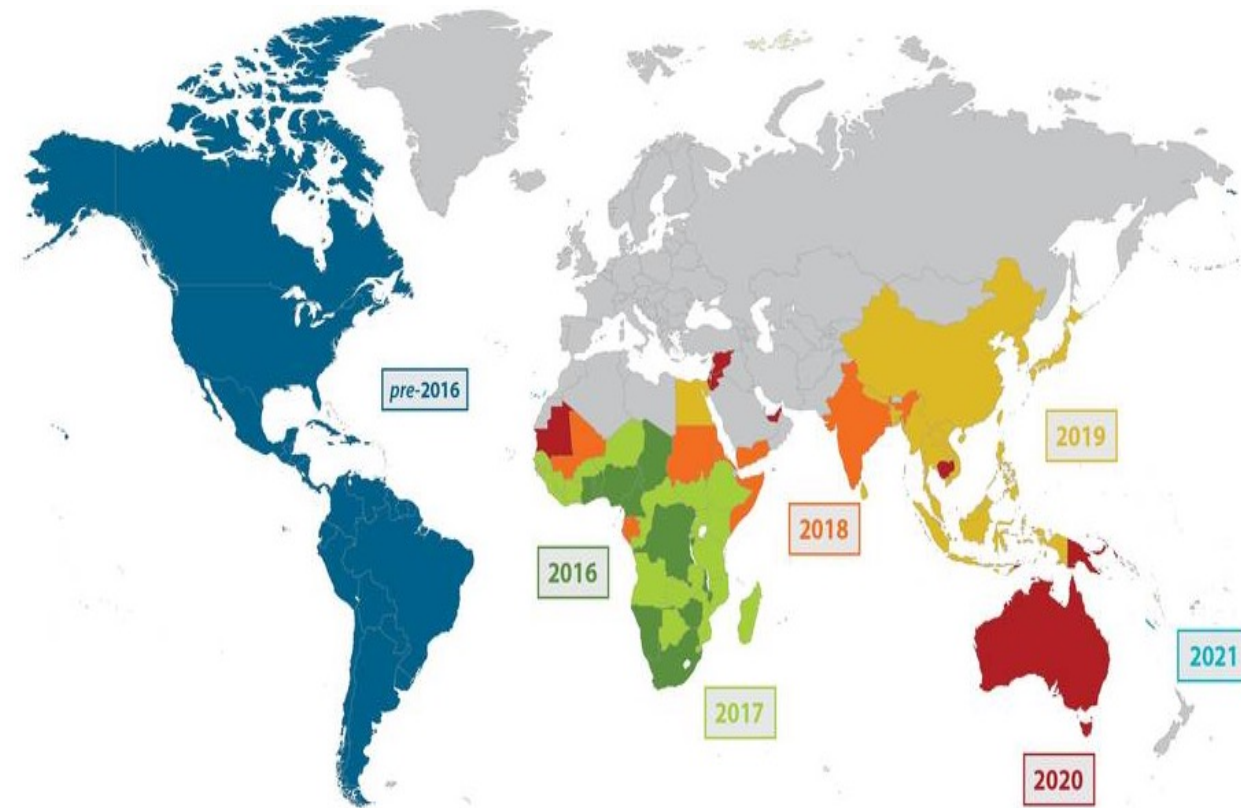
Unintended consequence of the Green Revolution – Transboundary pest infestations

Geographical Distribution of Transboundary Pest Infestations

Wheat Rust

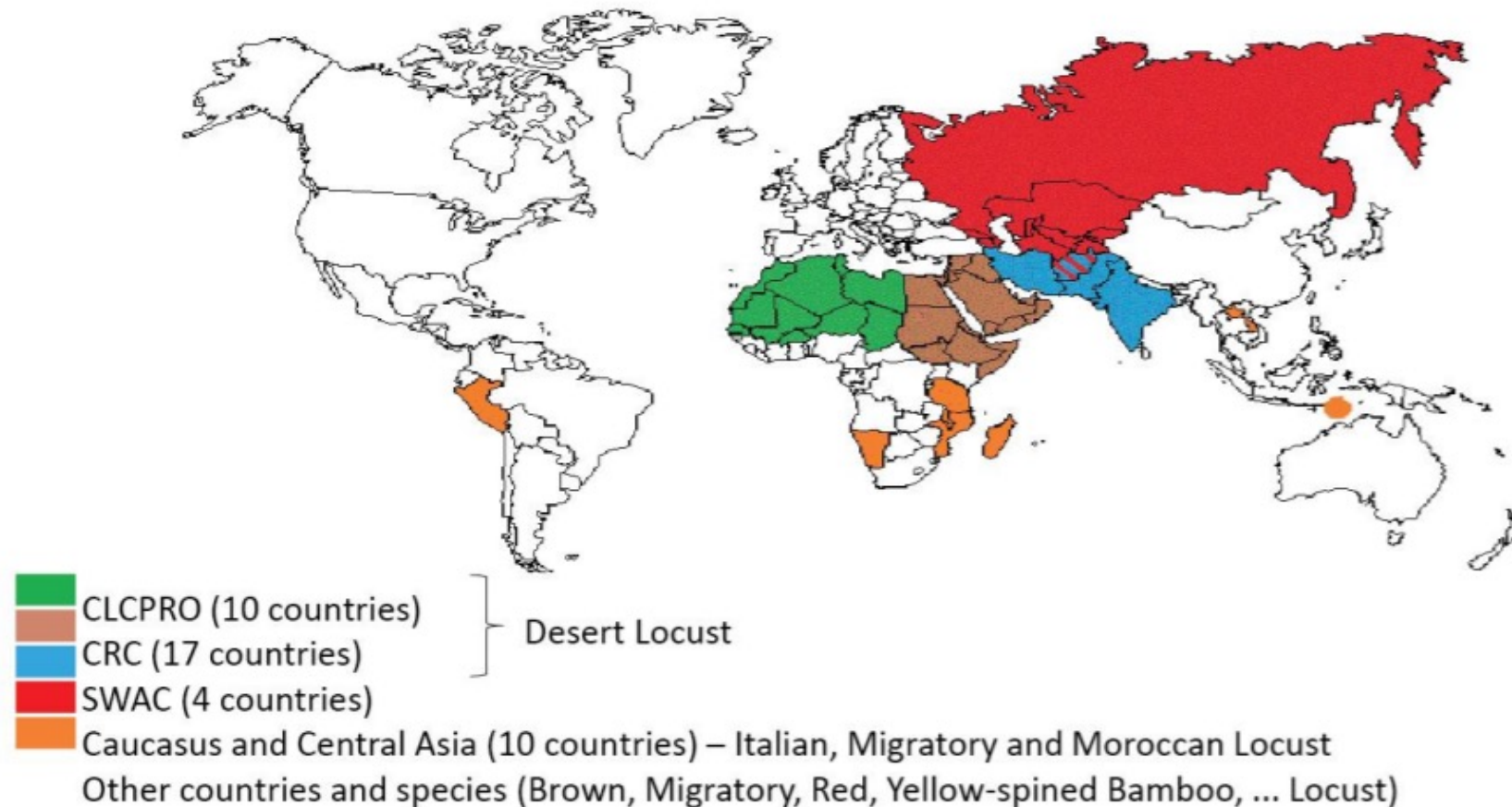


Fall Armyworm (FAW) Spread



Geographical Distribution of Transboundary Pest Infestations

Desert Locust



Economic Losses of Transboundary Pest Infestations

Predicted Economic Losses:

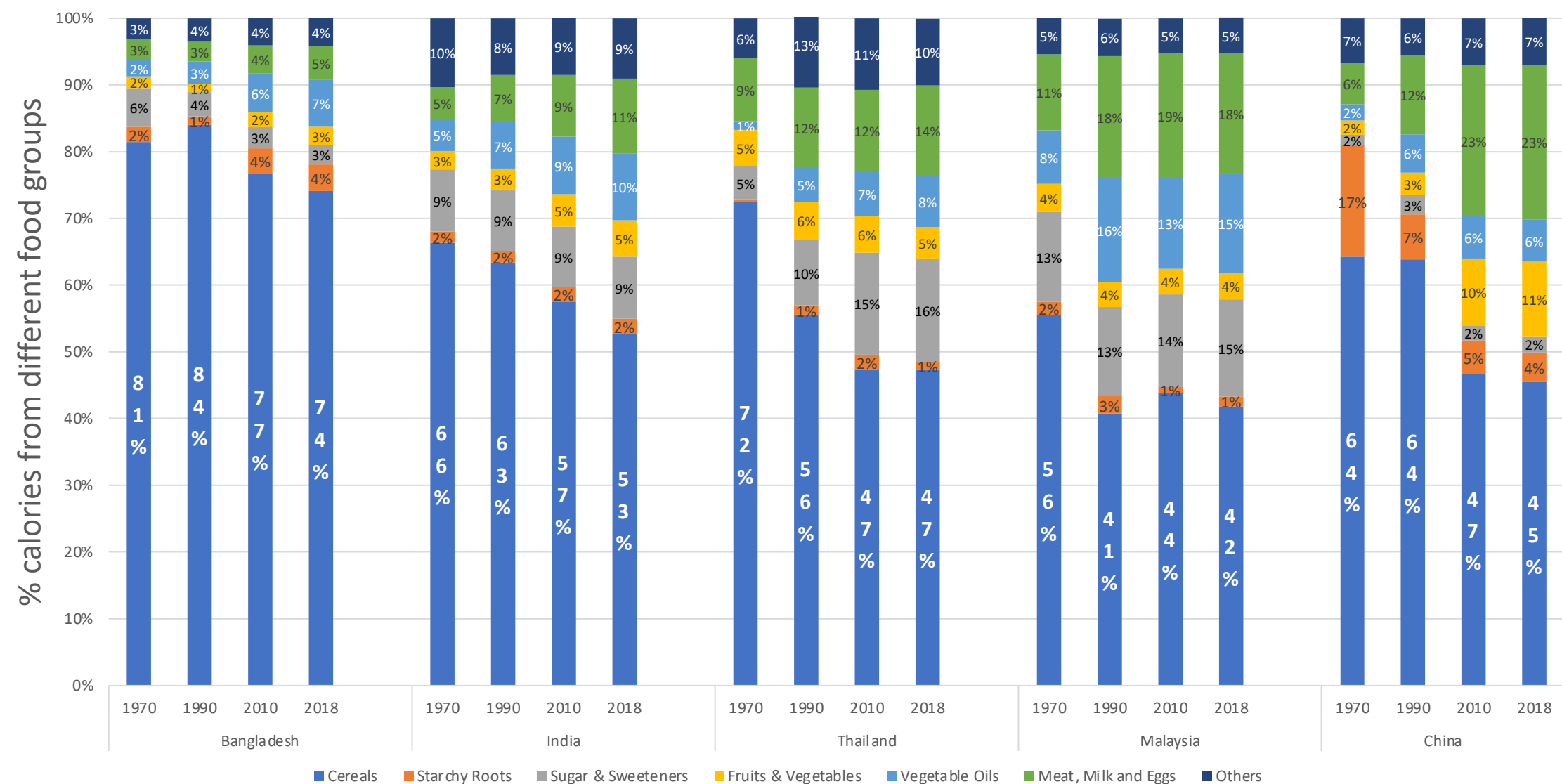
- Wheat rust losses estimated at ~ \$3 Billion every year. (CIMMYT)
- Fall Armyworm (FAW) losses in maize crops estimated to be \$4.6 Billion every year. (FAO)
- Brown Plant Hopper (BPH) leading to an overall economic loss of \$300 million in Asia annually.
- World Economic Forum reports total costs of plant diseases in the global economy to be more than \$220 Billion, and invasive insects like desert locusts costing at least \$70 Billion per annum.

Food System Transformations over time

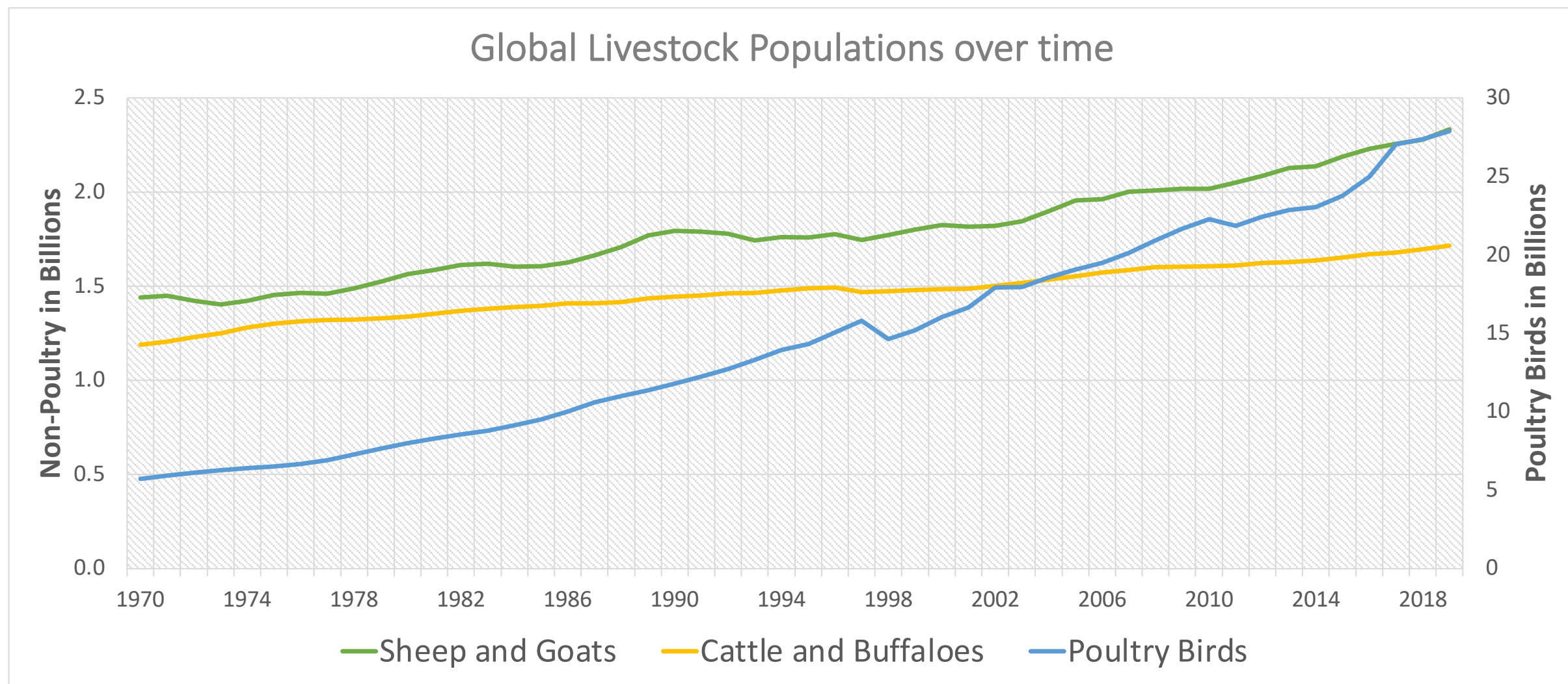
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Diversifying of calorie sources – Less reliance on cereals over time, increase in meat and FFV consumption

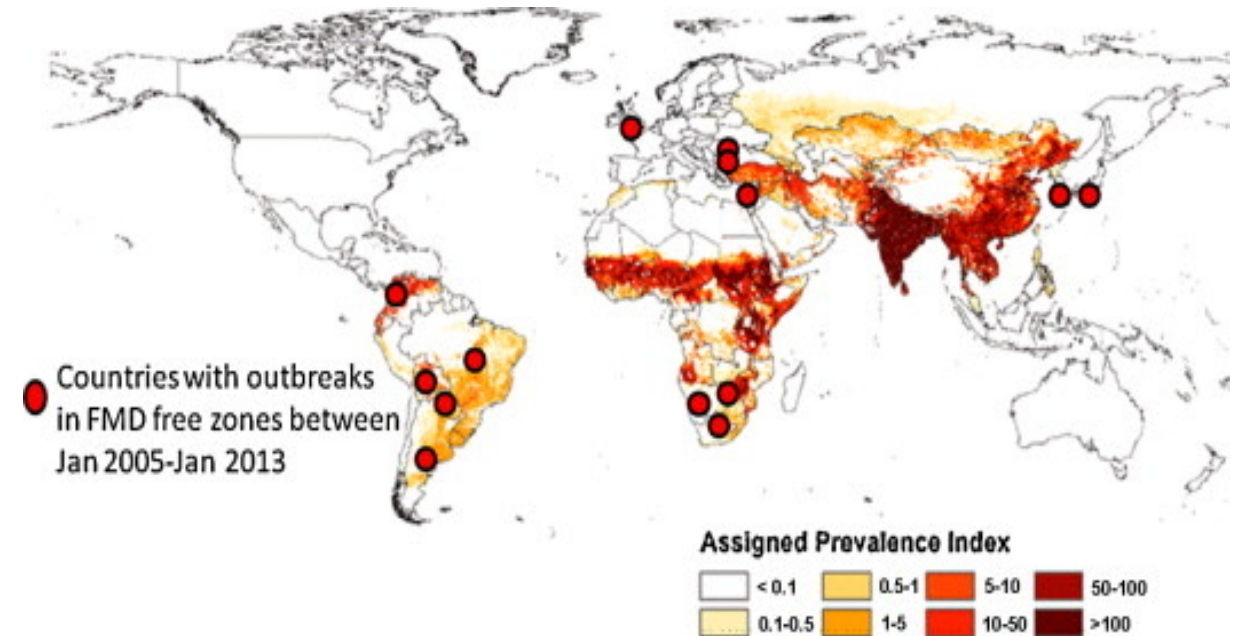


The livestock revolution-Phenomenal increase in the total number of livestock over the past 5 decades



The livestock revolution- Increase in livestock linked with an increase in livestock and zoonotic diseases

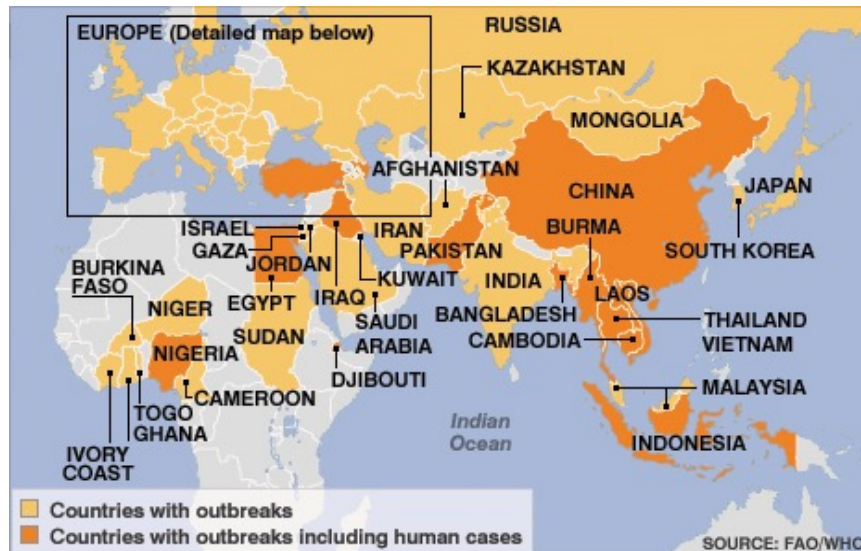
- Increase in frequency of livestock diseases such as the Foot and Mouth Disease (FMD)- Includes the 2005 China outbreak, 2007 UK outbreak and 2010-11 Japan, South Korea outbreak.
- Bovine spongiform encephalopathy (BSE) popularly known as mad cow disease had multiple outbreaks in the 21st century.
- Global losses due to Foot and Mouth Disease (FMD) are estimated to be at least \$6.5 billion annually



Zoonoses and Global Food Systems

- **Zoonoses:** A disease that can transfer from vertebrate animals to humans. (WHO)
- Avian influenza is a zoonotic disease that has had numerous outbreaks in the recent past.
- The cost of Asian Avian Influenza H5N1 in Asia alone was estimated to be \$10 Billion- Up to 200 million domestic birds either died or had to be culled.

H5N1 countries affected between 2003-2008



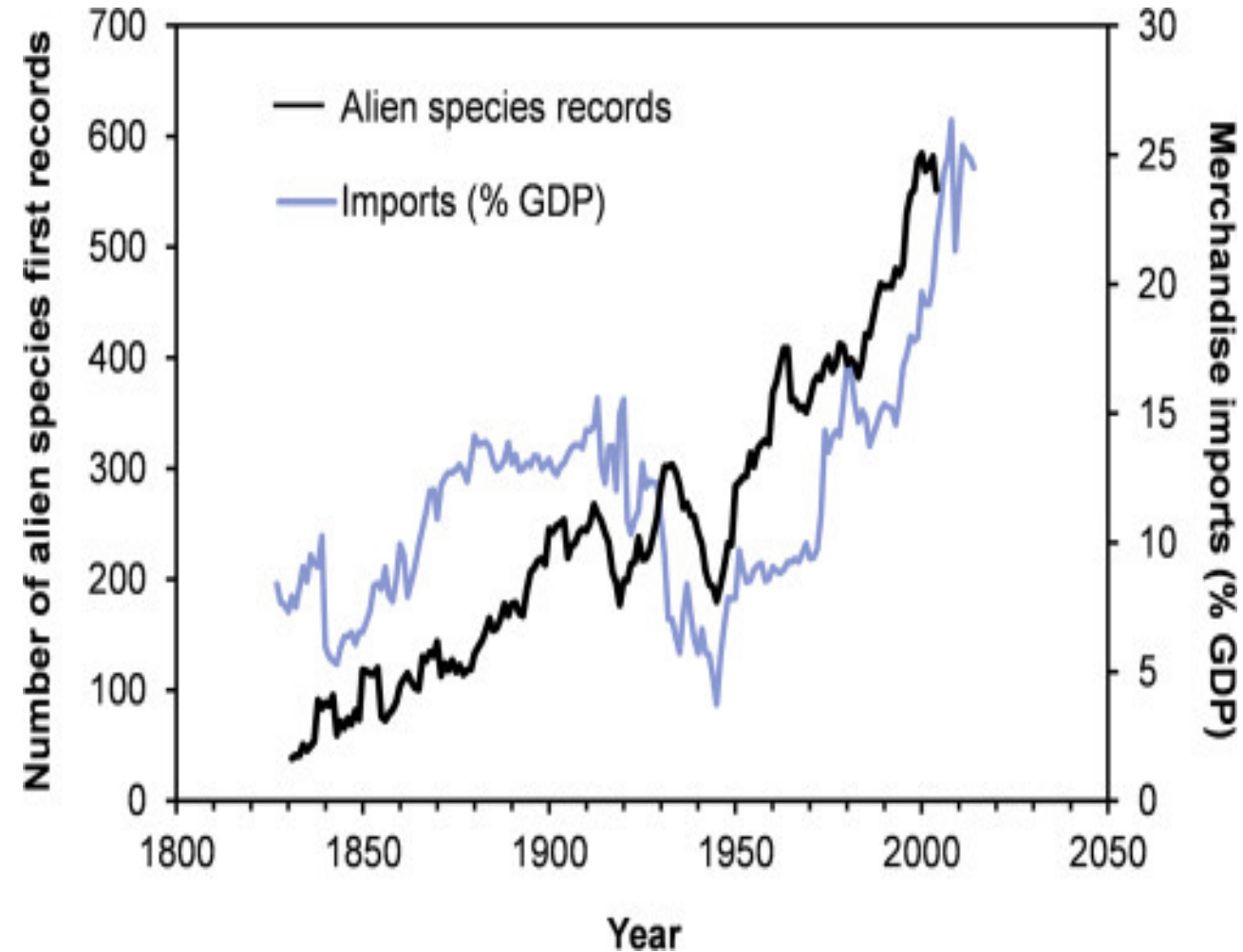
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Globalization and biosecurity

- Increase in trade and globalization is leading to an increase in biosecurity risks.
- There is a positive relationship between value of imports and total number of alien species.
- 77% of invasive pests in tropical Africa in the past 25 years have been introduced due to trade linked activities.
- Non-Native Species (NNS) account for economic losses of \$162 billion in the United States annually.
- The speed of pest and disease movement has also become much faster.



Are organic and local food systems safer?

- Local food systems are more resilient in the face of market disruptions or pandemics.
- However, “Organic” does not necessarily translate into “Safe”.
- Organic produce is just as susceptible to harmful pathogen like E. Coli and Salmonella.
- Studies from Kansas State University found no difference in prevalence of E. Coli between organically and conventionally raised cattle.

**Organic food
no guarantee
against
foodborne
illness**

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Climate change and the rise of plant and animal diseases

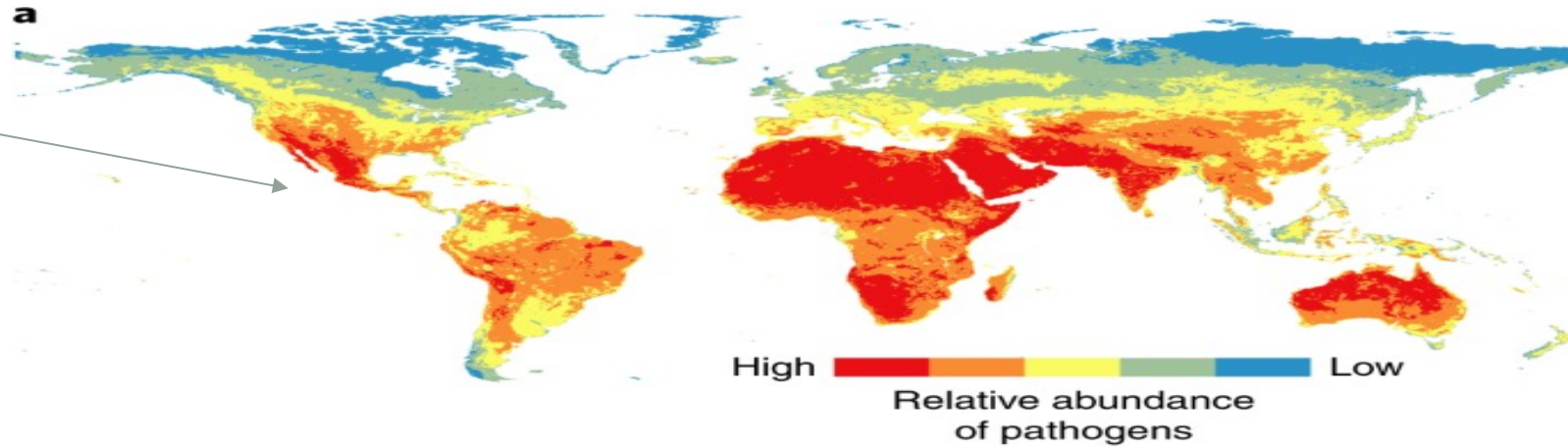
- There is a positive correlation between climate change and agricultural pests, and the risk of emerging zoonotic diseases.
- “An increase in temperature and precipitation levels favors the growth and distribution of most pest species by providing a warm and humid environment and providing necessary moisture for their growth.” (CIMMYT)
- Since 1960, crop pests and diseases have been moving at an average of 3 km a year in the direction of the earth’s north and south poles as temperatures increase



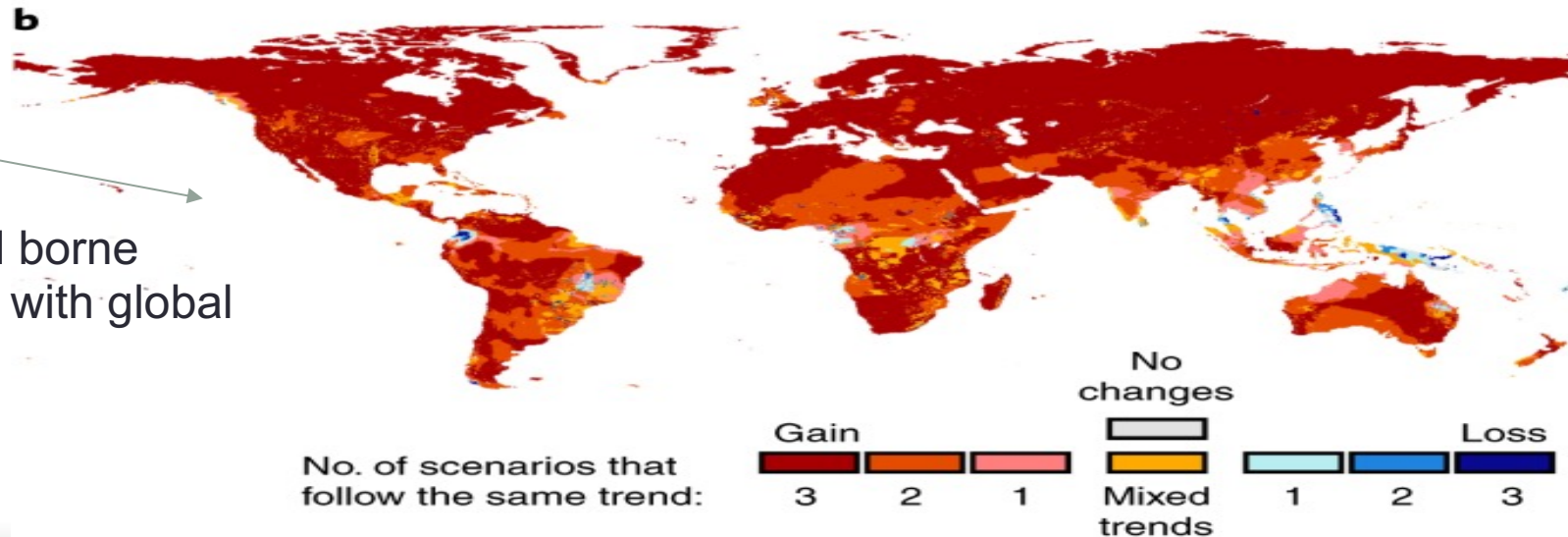
Wheat Stem Rust
CIMMYT/Petr Kosina

Current relative abundance and temporal projections (2050) of potential plant pathogens across the globe

Current



2050



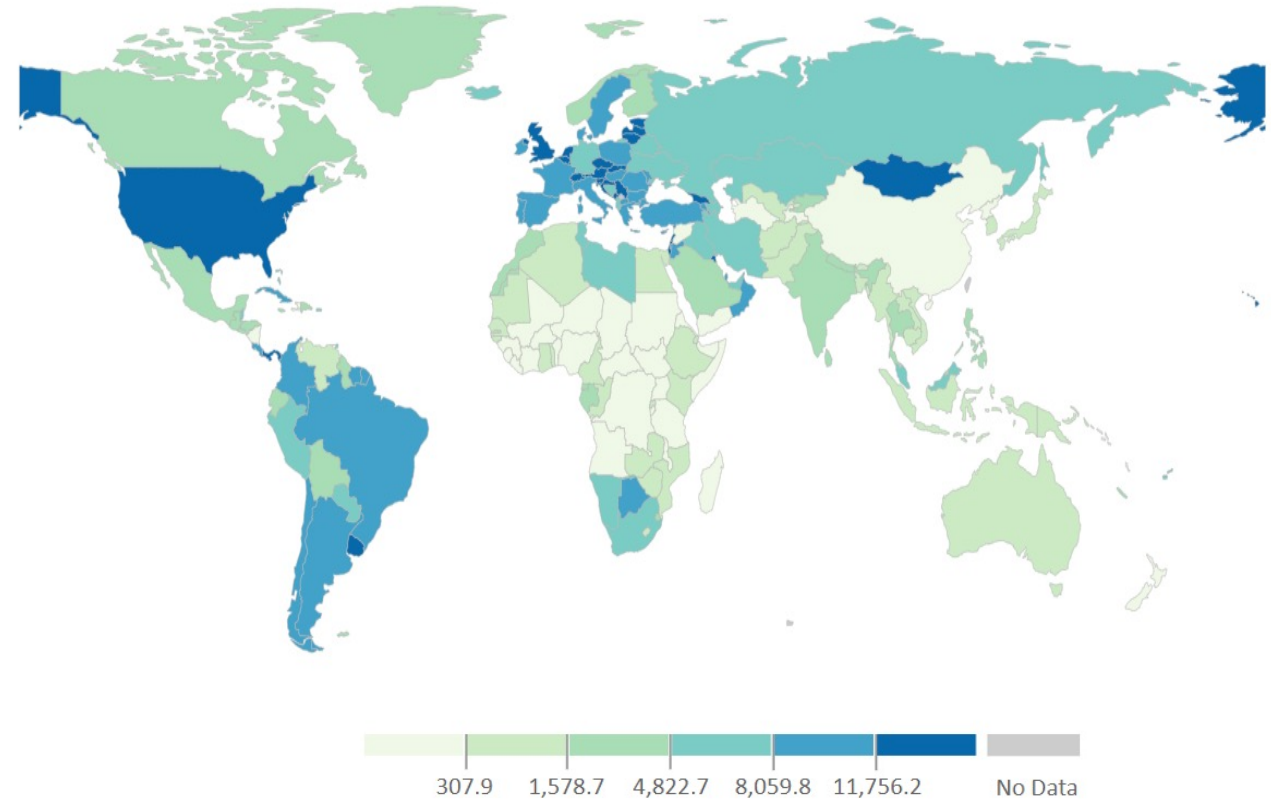
The proportion of soil borne pathogens increases with global warming

Source: Delgado-Baquerizo et. al, 2020

Covid 19 and Global Food Systems

- COVID-19 classified as a zoonotic disease by the WHO- One type of biosecurity issue
- Despite short term shocks due to labor and supply chain disruptions, food systems have proved to be resilient in the face of the pandemic
- In developing countries, perishable product supply chains were more effected than staple grain systems.
- Covid related rise in food insecurity is associated with diminished access to food due to income loss, especially for migrant labor, rather than a shock to the supply system.

Global Cumulative cases of Covid-19 reported per 100,000 population



Source: CDC

Building Resilience against Biosecurity Risks

Prevention vs Control

Developing Country Small Farm Agricultural Systems

- Promote Diversified and mixed farming systems in place of large-scale monocultures
- “Good Agricultural Practices” (GAP) for horticulture and livestock products
- Create scale by aggregating produce through farmer producer organizations
- Climate resilient food systems that resist novel pest infestations

Value Chain Investments

- Rural Market infrastructure, including water & sanitation
- Temperature controlled transport & storage systems
- Investing in supply chain traceability

Building Resilience against Biosecurity Risks (continued)

Societal Investments

- Research and Technology development for managing biosecurity risks (eg. Pest resistant varieties)
- Systems for biosecurity information exchange. (E.g. Locust watch dashboard by FAO)
- Better data systems including AI and machine learning to monitor pests and diseases
- Incorporate One Health Approach in Policy Making
- Public health infrastructure investments, including access to health services for the poor
- Behavior change at the individual and community level that promotes safe food systems

Thank You!



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