A more volatile world: implications for food security and how to achieve it

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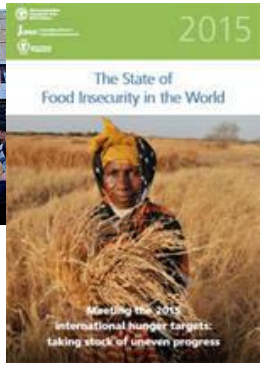
What is food security?



"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". (World Food Summit, 1996)

"9 meals from anarchy" & "hunger challenge" food security: is the short term supply of food assured to allow people to eat when they are hungry?

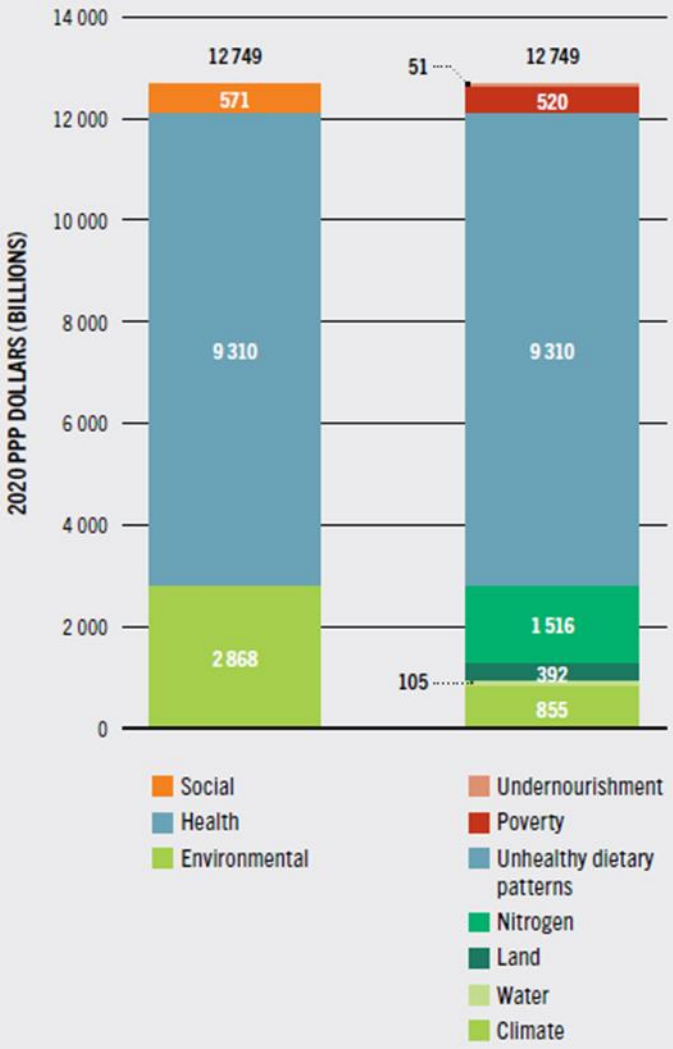
"**market-led" food security**: can the market supply the sorts of food people like to eat, cheaply? The cheap-food focus ignores the costs externalised to the environment and health systems.

"**Sustainable" food security**: can the market be structured to supply food that people like and want, and that underpins a healthy diet, and is supplied sustainably (i.e. costs are not levied on health and environment)?

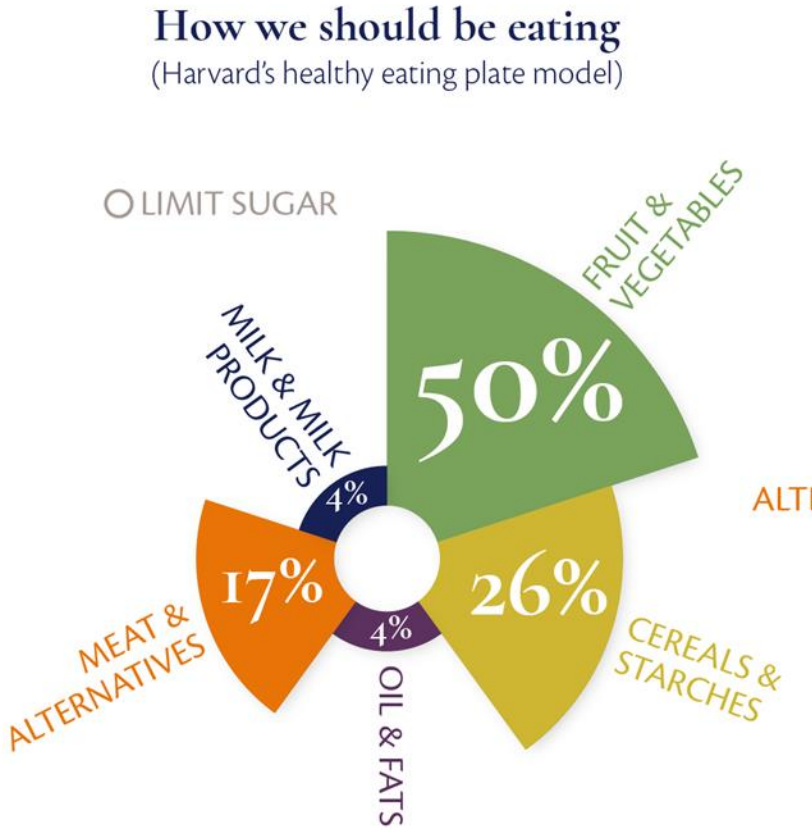
WHY ARE WE WHERE WE ARE TODAY?

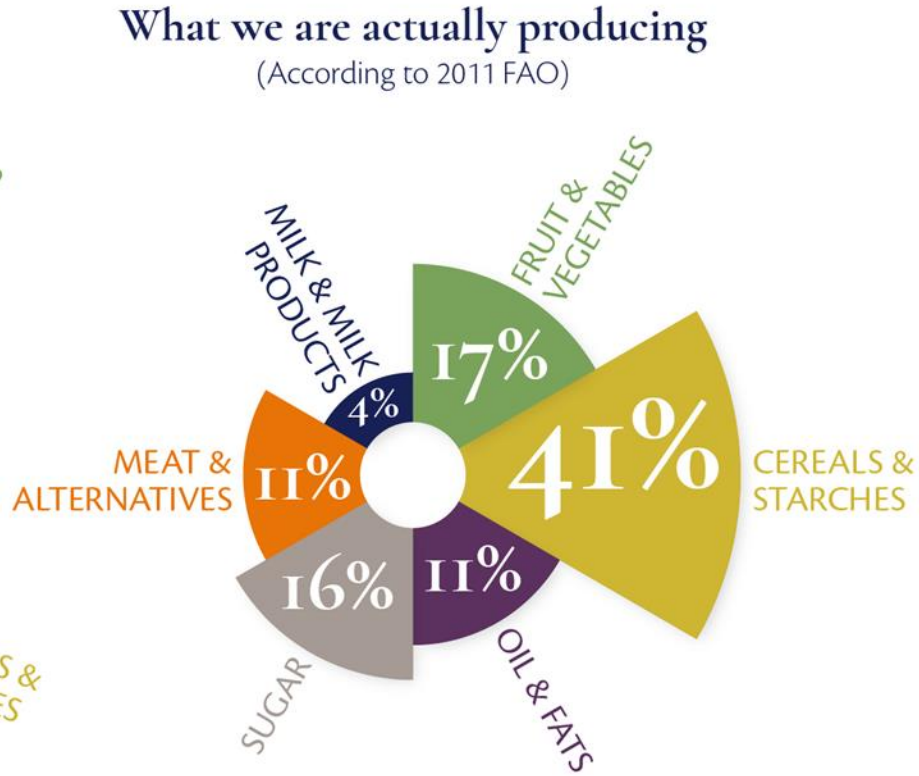
Taking a food systems approach reveals “Jevons’ paradox” writ large

FIGURE 6 QUANTIFIED HIDDEN COSTS OF AGRIFOOD SYSTEMS BY COST CATEGORY (LEFT) AND SUBCATEGORY (RIGHT), 2020



NOTE: All values are expected values.
SOURCE: Lord, S. 2023. *Hidden costs of agrifood systems and recent trends from 2016 to 2023 – Background paper for The State of Food and Agriculture 2023*. FAO Agricultural Development Economics Technical Study, No. 31. Rome, FAO.

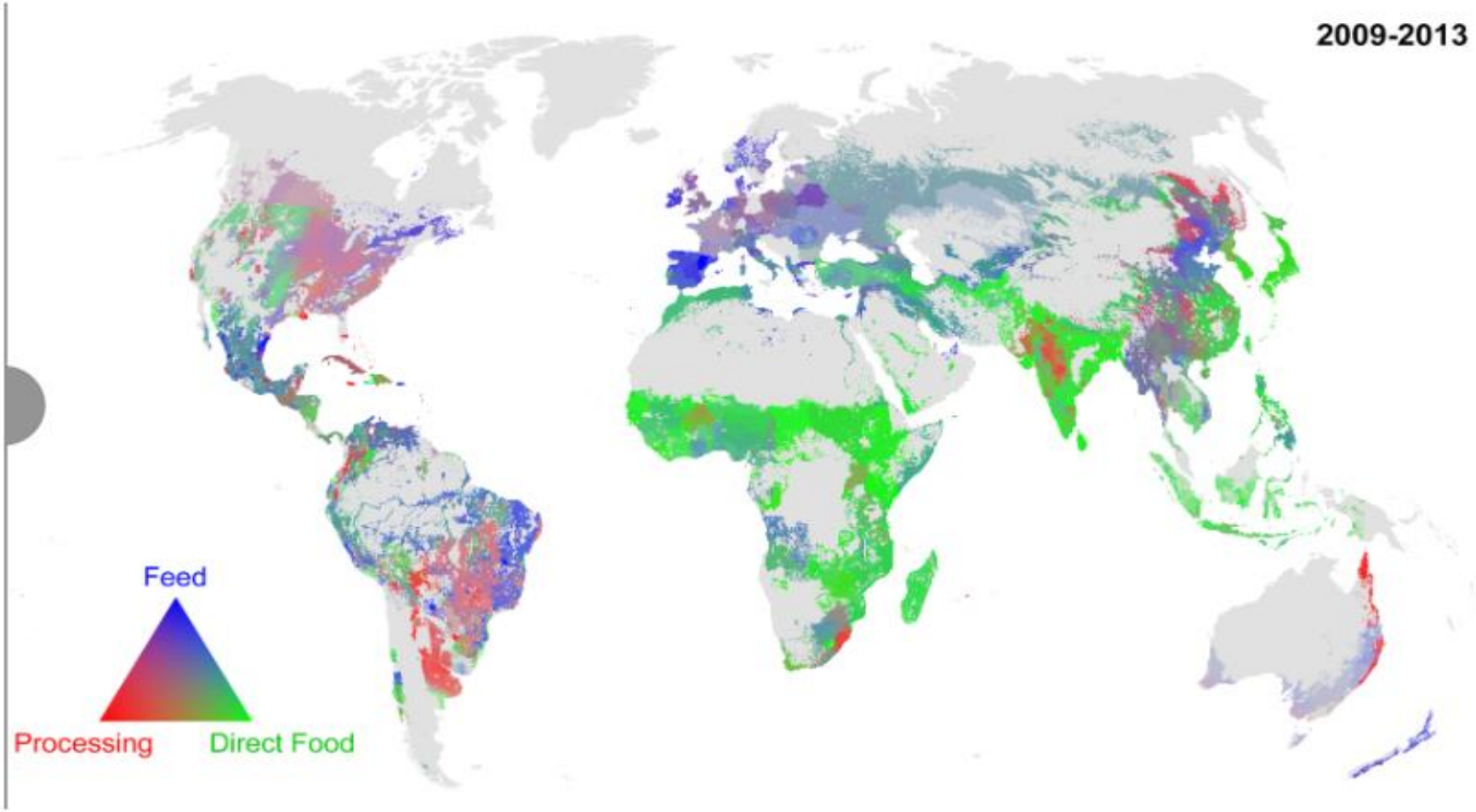




Where is food grown?

How crops are used varies around the world

Average fraction of harvest used for direct food, feed, and processing



Source: Ray, D. K., Sloat, L. L., Garcia, A. S., Davis, K. F., Ali, T., & Xie, W. (2022). Crop harvests for direct food use insufficient to meet the UN's food security goal. Nature Food, 3(5), 367-374.

WORLD RESOURCES INSTITUTE

A systems approach highlights the Jevon's paradox

William Stanley Jevons

The paradox: Increasing production efficiency ***increases*** *demand (through lowering prices)*

Over the last 60 years, we have reduced the price of food and increased its availability, whilst growing the agri-food economy. Political dialogue remains largely focused on producing more food As a result, collectively we waste and overeat more, and repurpose "excess production" – such that across the EU, over 60% of all grain production is fed to livestock, reducing the price of meat.

The “cheaper food paradigm” (CFP) drives interlocking vicious circles

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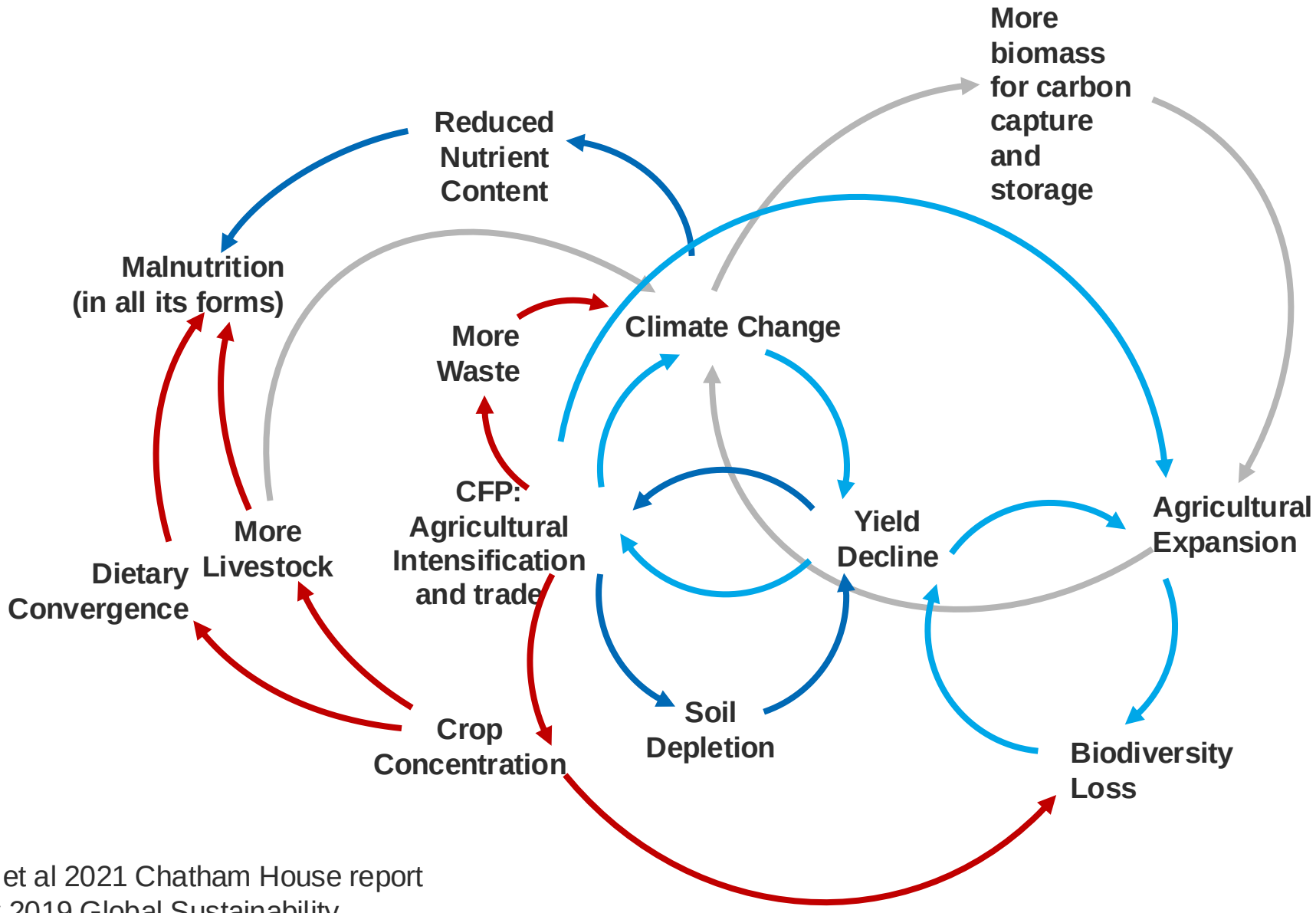
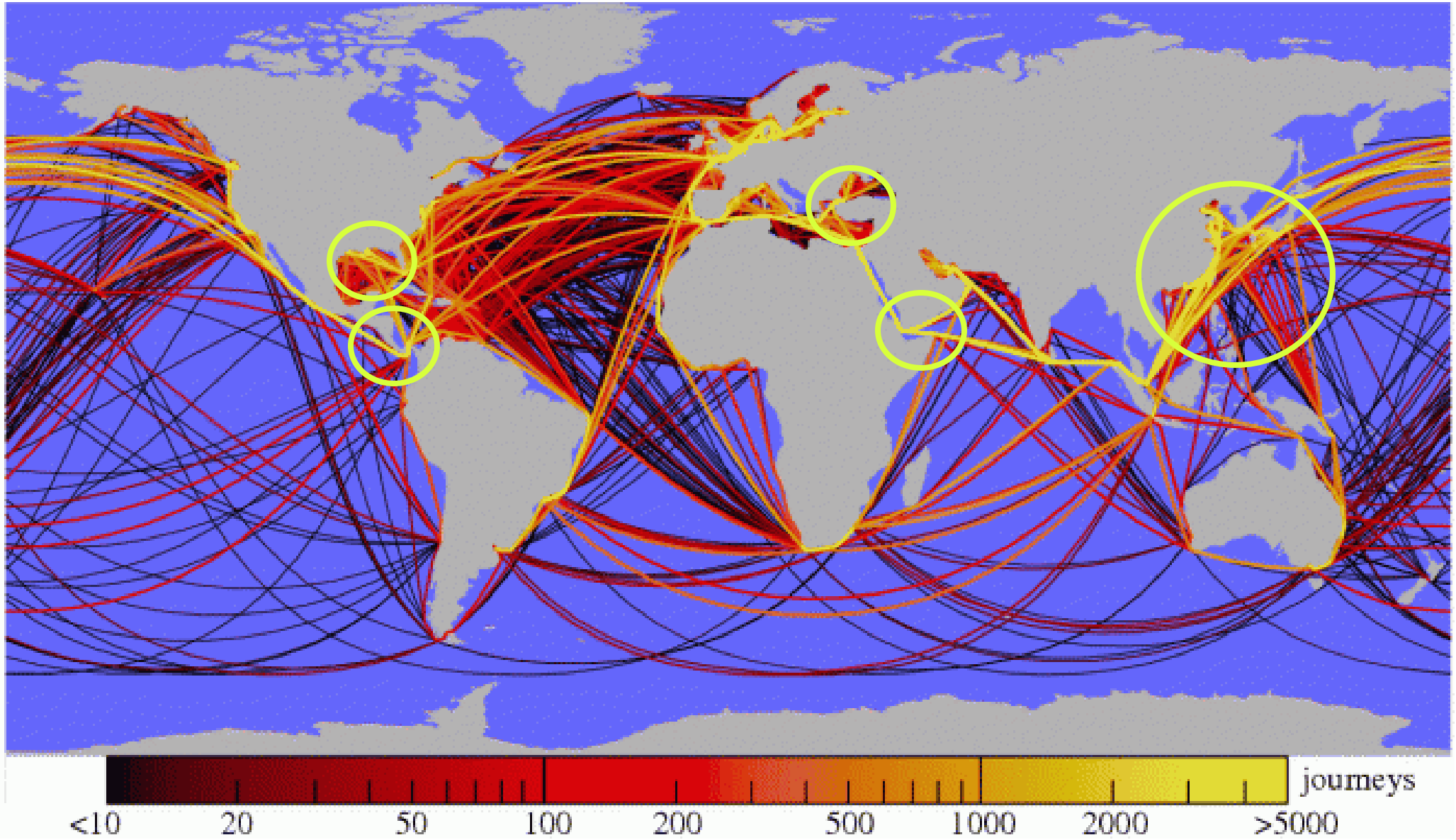


Source: Benton et al 2021 Chatham House report
Benton & Bailey 2019 Global Sustainability

THE FOOD SYSTEM IS NOT RESILIENT AS WELL AS UNSUSTAINABLE

Food security is about trade at a global and local level

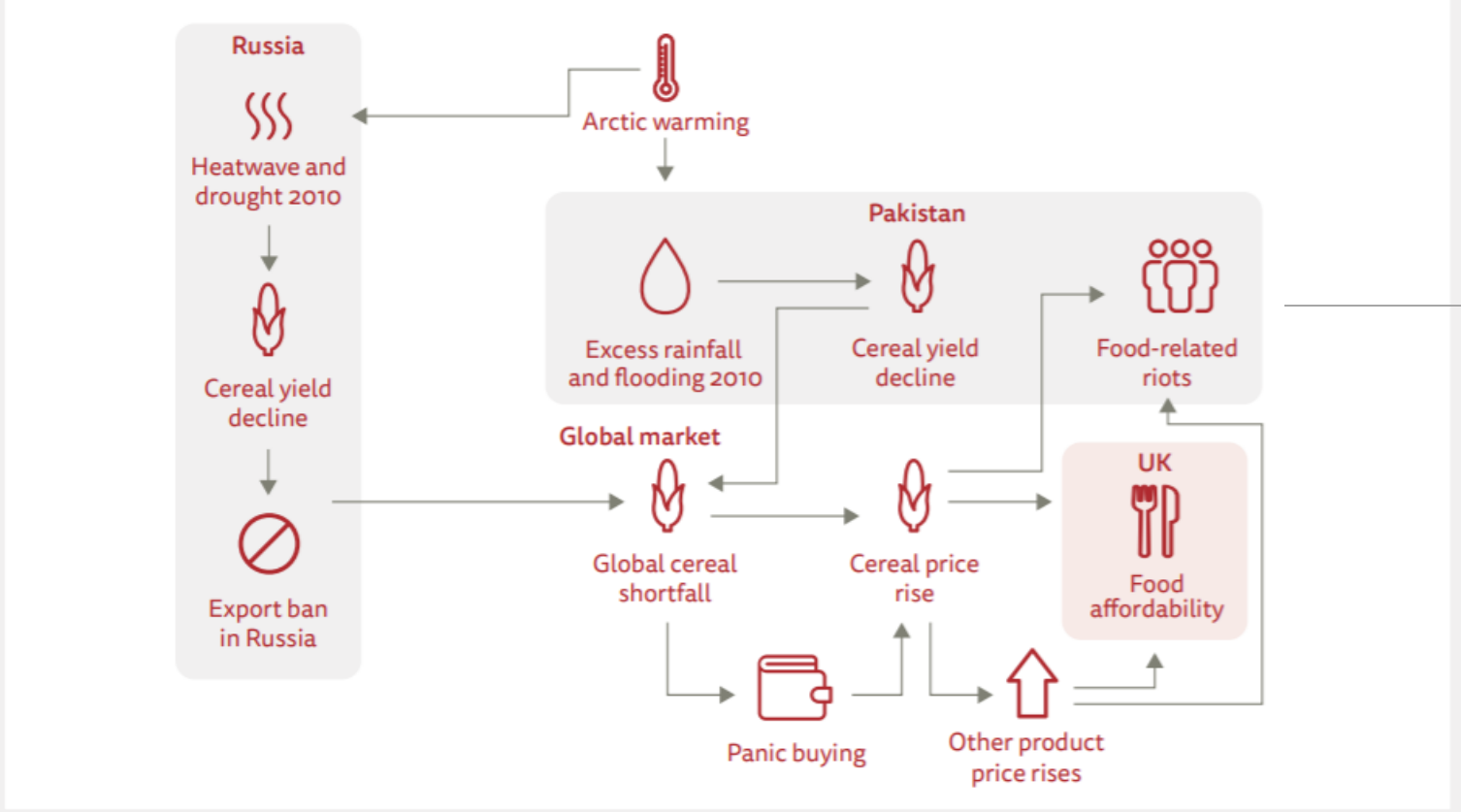
Flour (39%) (**Wheat** Flour, Calcium, Iron, Niacin, Thiamin), **Milk** Chocolate (30%) [Sugar, Cocoa Butter, Cocoa Mass, Dried Skimmed **Milk**, Dried Whey (**Milk**), Butter Oil (**Milk**), Vegetable Fats (Palm, Shea), Emulsifiers (**Soya** Lecithin, E476), Natural Flavouring], Vegetable Oil (Palm), Wholemeal **Wheat** Flour (9%), Sugar, Glucose-Fructose Syrup, Raising Agents (Sodium Bicarbonate, Malic Acid, Ammonium Bicarbonate), Salt



https://www.chathamhouse.org/2017/06/chokepoints-and-vulnerabilities-global-food-trade

Risk cascade (example from CCRA2): supply shock

Figure 1. An example of cross-border impacts: drought and food prices[5]



- Destabilisation of fragile economies (Arab Spring, Syria)
- Movement of people into the EU
- Rise of nationalism

Jet stream dynamics leads to connected weather extremes

Environmental Research Letters

LETTER • OPEN ACCESS • IOPSELECT

Evidence for a wavier jet stream in response to rapid Arctic warming

Jennifer A Francis[1] and Stephen J Vavrus[2]

Published 6 January 2015 • © 2015 IOP Publishing Ltd
Environmental Research Letters, Volume 10, Number 1

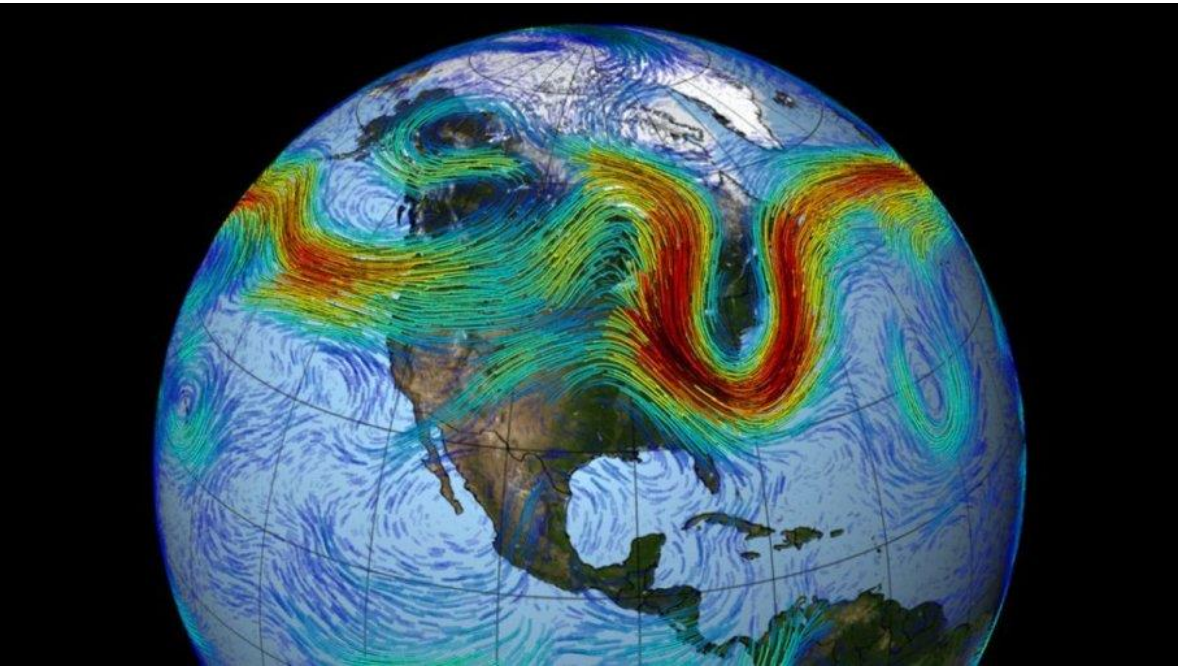
SCIENTIFIC REPORTS

OPEN

Influence of Anthropogenic Climate Change on Planetary Wave Resonance and Extreme Weather Events

Received: 03 January 2017
Accepted: 20 February 2017
Published: 27 March 2017

Michael E. Mann[1], Stefan Rahmstorf[2], Kai Kornhuber[2], Byron A. Steinman[3], Sonya K. Miller[3] & Dim Coumou[3,4]



…which have the potential to lead to compound effects globally (e.g. multiple breadbasket impacts)

https://www.britannica.com/science/Rossby-wave

“Sustainable” intensification & land sparing to meet inevitably increasing global food demand

Agro-ecological approaches (land sharing) and land-sparing enabled by demand-reduction through adopting healthy, sustainable, low-waste consumption.

CONTESTED VISIONS FOR A “SUSTAINABLE FOOD SYSTEM”

…each vision is based on sets of (mainly ideological) assumptions, so is a “social choice”

Benton, Tim G., and Helen Harwatt. "Sustainable agriculture and food systems." (Chatham House, 2022).

Core issues at the heart of the debate

Sustainable Ag Version 1
"Sustainable" intensification & land sparing to meet inevitably increasing global food demand
Key Assumptions
Demand is exogenous and **will increase** as population size and wealth increase
Growing market demand **requires** productivity growth to raise supply
Dietary change is *difficult* and **not** the preserve of policy
The potential for technologically led sustainable intensification is **large**
Land sparing is **enabled** by sustainable intensification

Sustainable Ag Version 2
Agro-ecological approaches (land sharing) and land-sparing enabled by demand-reduction through adopting healthy, sustainable, low-waste consumption.
Key Assumptions
Demand **can** be changed and should be shaped by social needs through regulatory change leading to structural change in markets
The current unsustainability of farming is a form of **market failure** that can be corrected
A **healthy** diet is also a (more) **sustainable** one
Agro-ecological approaches can supply sufficient nutrients to "feed the world" **if consumption patterns change**
Agro-ecological approaches are **more sustainable** than sustainable intensification

TODAY’S SYSTEM IS LOCKED-IN

The food system has a lack of functional resilience but a lot of structural resilience

The cheaper food paradigm

Consumption drives economic growth

Cheaper food is good for growth

Markets provide the solution

Changing diets is not the role of governments

Social safety nets are not needed

Ill-health from poor diets not accounted for

Waste is economically rational

Ultra-processed foods are cheap to produce and buy, and increasingly available

Policy stimulates market via:

- deregulating
- liberalizing
- driving efficiency through scale
- targeting state support at globally important commodities

Business models are based on growth in output and consumption

Farming focuses on a few commodities grown intensively and at scale

Market concentration

Markets are dominated by few, big players, with vested interest in the *status quo*

Competitors and disruptors face significant barriers to entry

Environmental impacts not costed

Unsustainable path dependencies

So much money has been spent by business interests, it is difficult to change tack

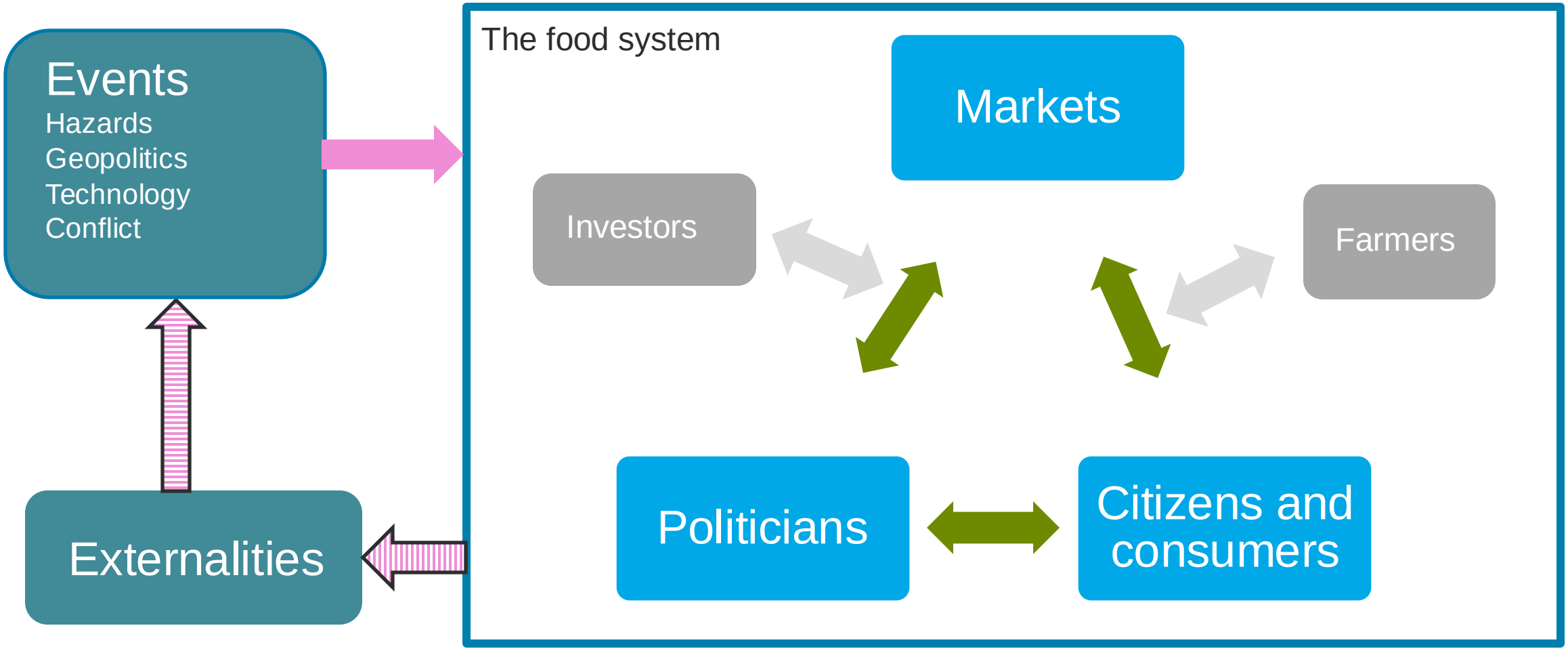
Near-monopolies exert big price pressures

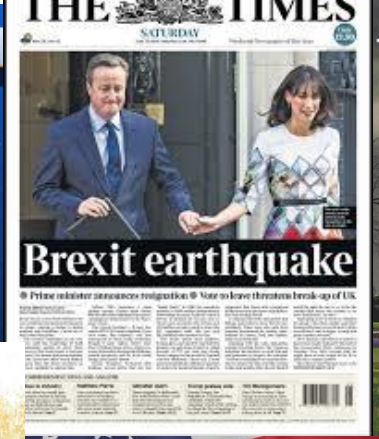
Innovation is driven by incumbents and focused on efficiency improvements to BAU

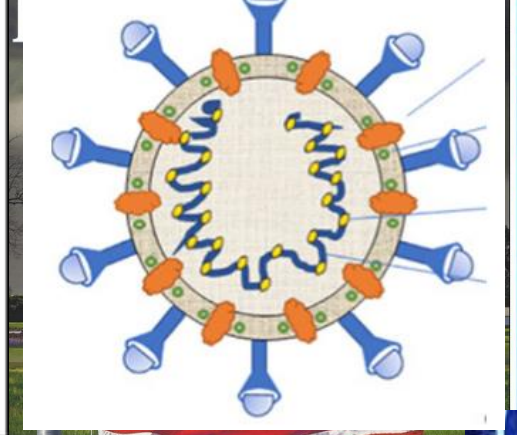
Transformative change is perceived as prohibitively challenging, politically and economically

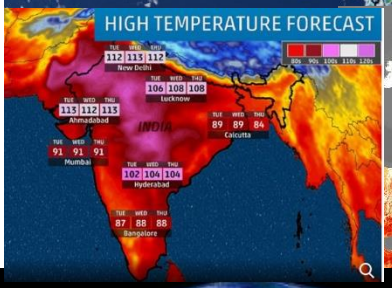
WHAT SHAPES THE FUTURE?

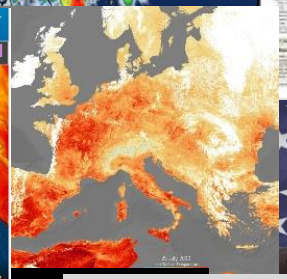
What shapes the future?

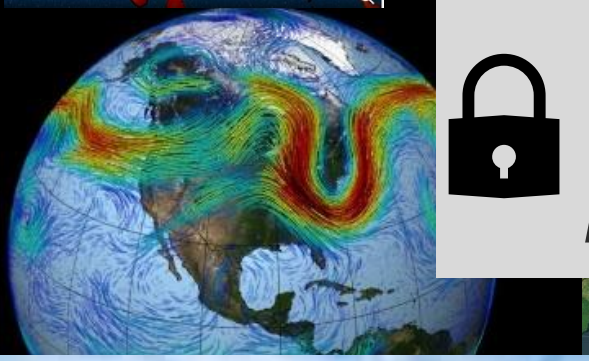




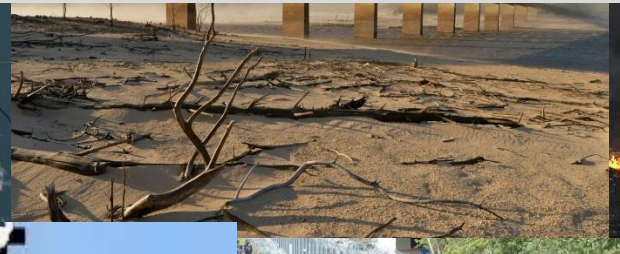


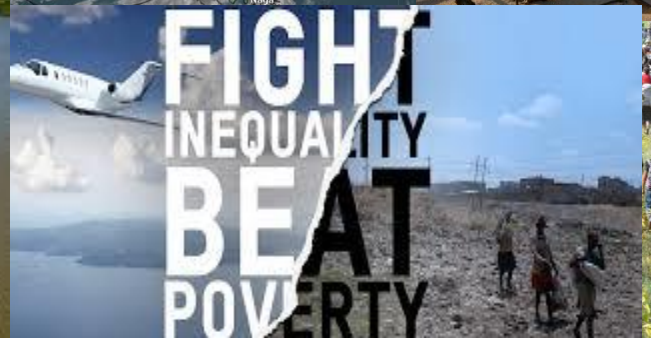






Events happen that reshape markets, politics and attitudes





THINKING ABOUT RISKS

Models probably under-estimate the hazards at the moment, and we often under estimate risks by ignoring cascading and compound effects

RISK=

HAZARD

Climate change slow-onset issues (e.g. gradual drying)
Changing weather, especially extremes
Spatial synchrony through teleconnections (e.g. jet stream)
Tipping points
Climate change on ecology

X

EXPOSURE

Will you get flooded?

How much does national/institutional/ financial/national security rely on goods from overseas that could be disrupted by hazards?

X

VULNERAB-ILITY

Do you have flood defences?

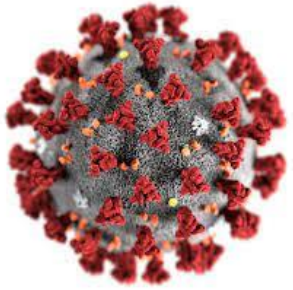
Are systems efficient but fragile (e.g. just-in-time)?

Shaped by political, economic and social factors (and also the ***perception*** of the hazard)

Extreme weather


unusual weather


Ecological impacts: pests


Ecological impacts: diseases

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RISK=

HAZARD
X
EXPOSURE
X
VULNERABILITY

Extremes (damaging weather, pests and diseases etc) ⬆

Global interconnectivity of economies ⬆
Global interconnectivity of risks ⬆
Slow action on climate change ⬆

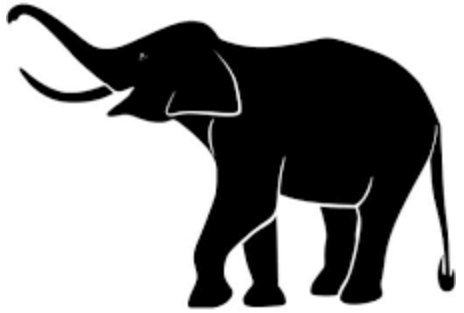
Lean economies, inter-connected across space, sectors and time. ⬆
Weakened int'l architecture of cooperation (rules based systems) ⬆
Geopolitical changes and disruptions ⬆
Polarising societies and attitudes ⬆
Increased inequality (exemplified by COVID-19) ⬆

The metaphorical zoo of future instability

e.g. *food disruption*: drought, flood, heatwave affecting one or more production areas; pests and diseases; disruption on port or transport infrastructure; disruption on centralised processing facilities; problems with labour caused by climate hazards (diseases, movement, instability) etc etc etc

Turbulent
Uncertain
Novel
Ambiguous

Black swan: rare, high-impact events



If there are 1000 potential black swan events, each at 1/1000 probability, then something is ***very*** likely to happen

If we can't predict the exact risks, only that "something will happen" we need to focus on resilience:

Properties of resilience to reduce exposure and vulnerability:

Ally shoring and/or diversification of supplies of critical goods.

Increasing self sufficiency/on-shoring.

Increasing redundancy/storage.

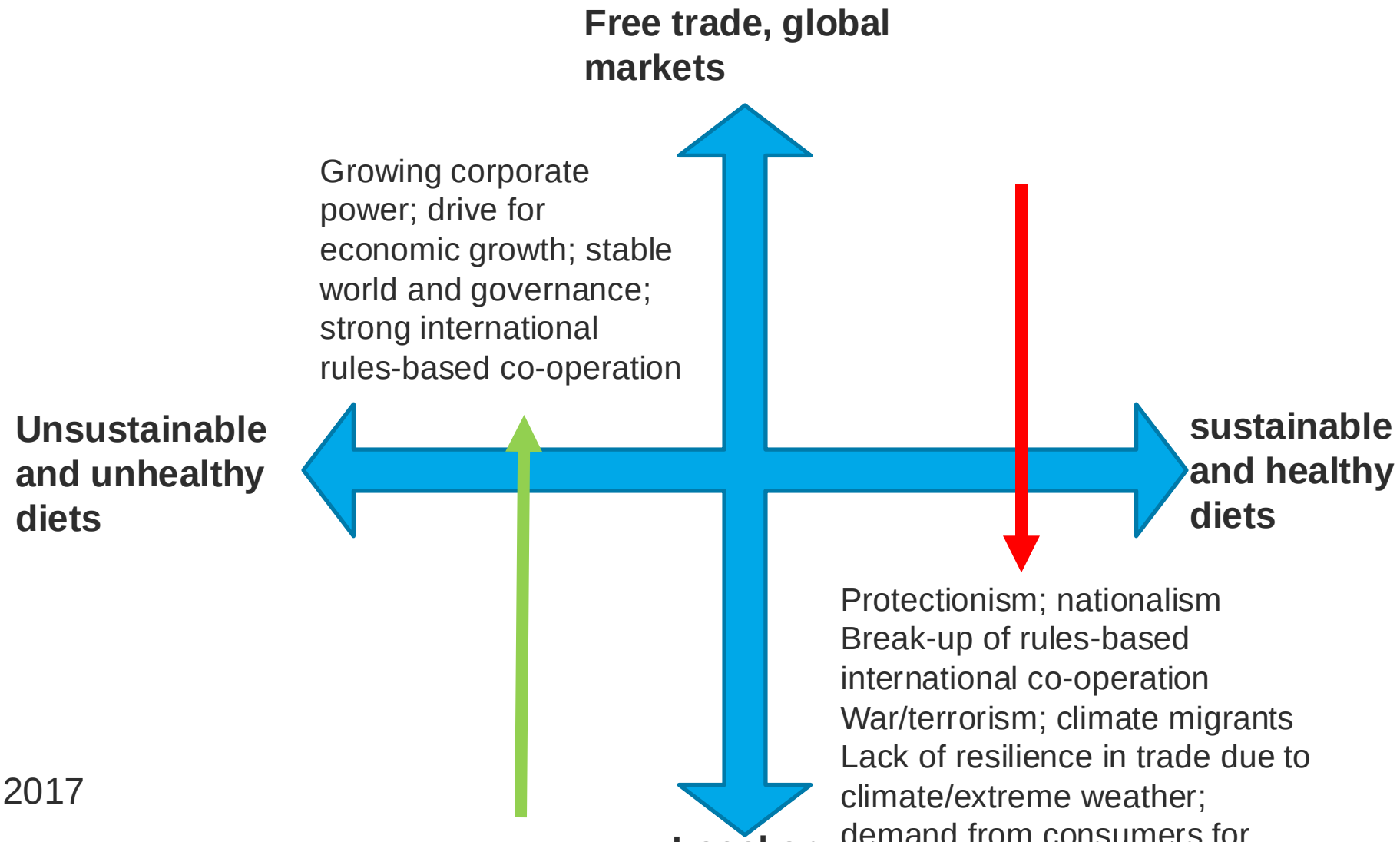
Avoiding single points of failure.

Development of increased flexibility/agility/ substitutability/or reducing demand and doing-without.

Early identification of and intervention in hotspots of risk.

Securitising food supply – increasing self-sufficiency, ally-shoring - for national security may make the world more unstable….

Future of food systems



2017

https://www.weforum.org/whitepapers/shaping-the-future-of-global-food-systems-a-scenarios-analysis

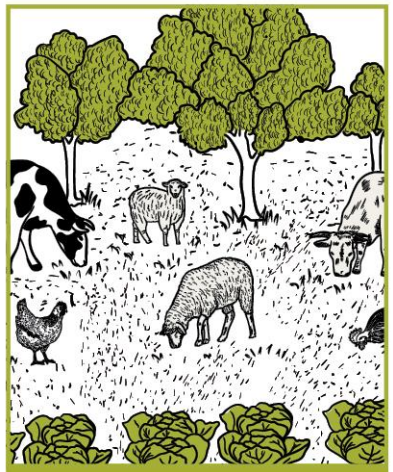
Changing worlds will change the space for action and what is not possible in today's world may suddenly become possible

https://www.agrifood4netzero.net/agri-food-system-2050.html

SCENARIO A

'BUILD BACK FAST AGAIN'

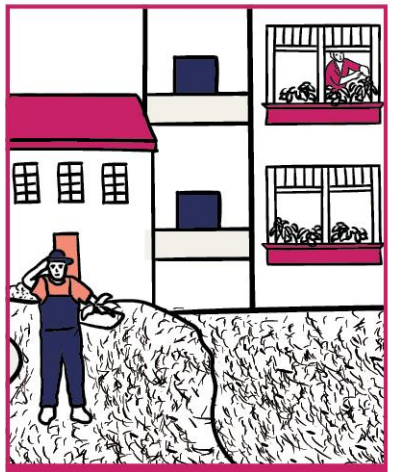
An unstable and globalised world, where economic growth is key (essentially business as usual)



SCENARIO B

'CIRCULAR WORLDS'

Geopolitically stable and globalised, underpinned by circular sustainable systems and values



SCENARIO C

'SELF-SUFFICIENCY'

An unstable, regionalised world, where a circular economy is driven by the need to save resources

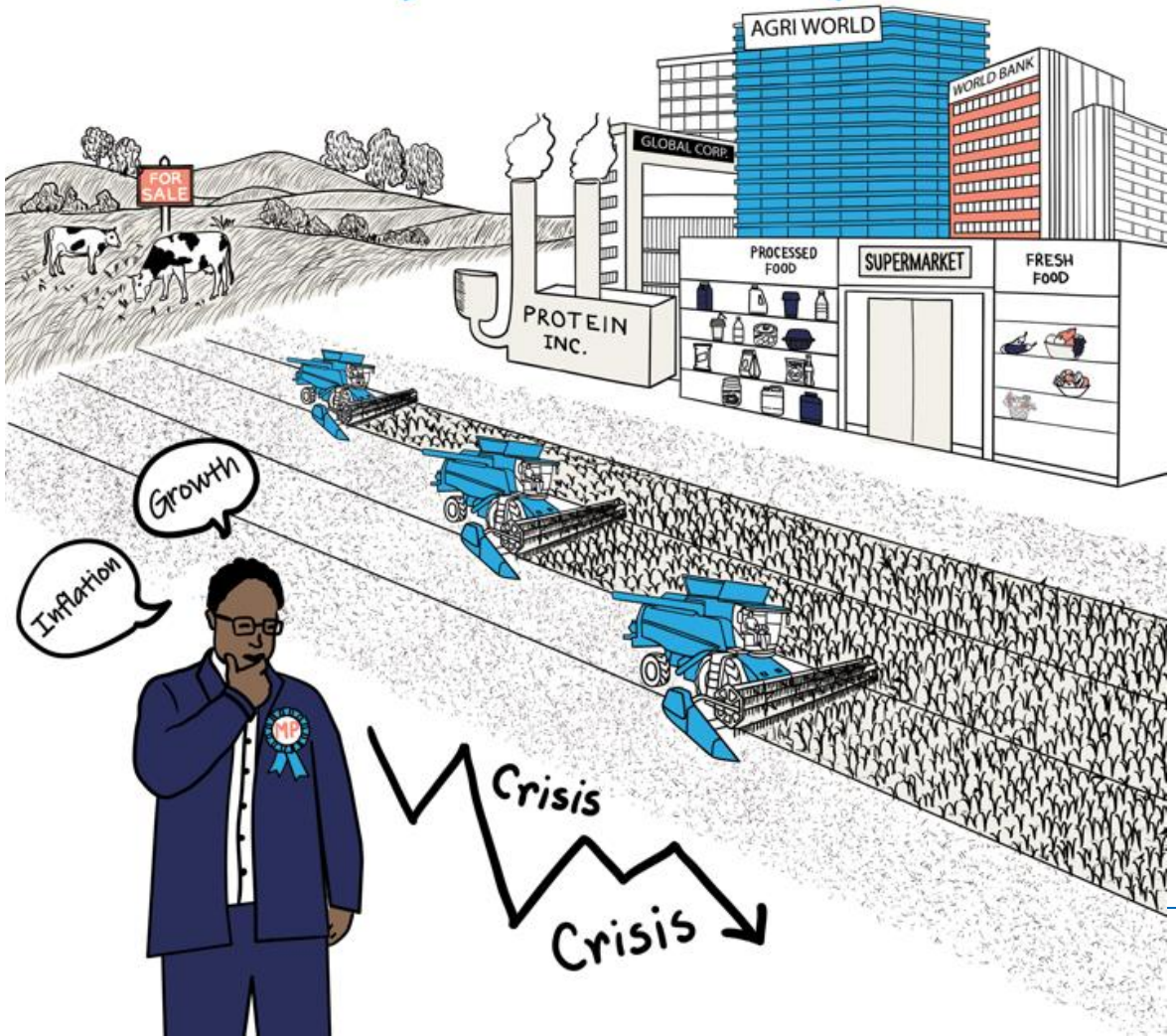
SCENARIO D

'THE RIGHT TO FOOD'

A geopolitically stable world, with a globalised economy built on 'green growth'.

SCENARIO A

‘BUILD BACK FAST (AGAIN)’



An unstable, globalized world which most values economic growth (BAU)

A world of ultra-processed foods, (un)sustainable intensification, land sparing, tech-driven. Much volatility – resilience is important.

Net zero arises through efficiency (to save money), resilience-building (e.g. improving soils to reduce climate impacts) and rewilding.

What would be needed?

Resilience building, and how to maximise mitigation when building adaptation? **Tech for RUE, yield maximisation**

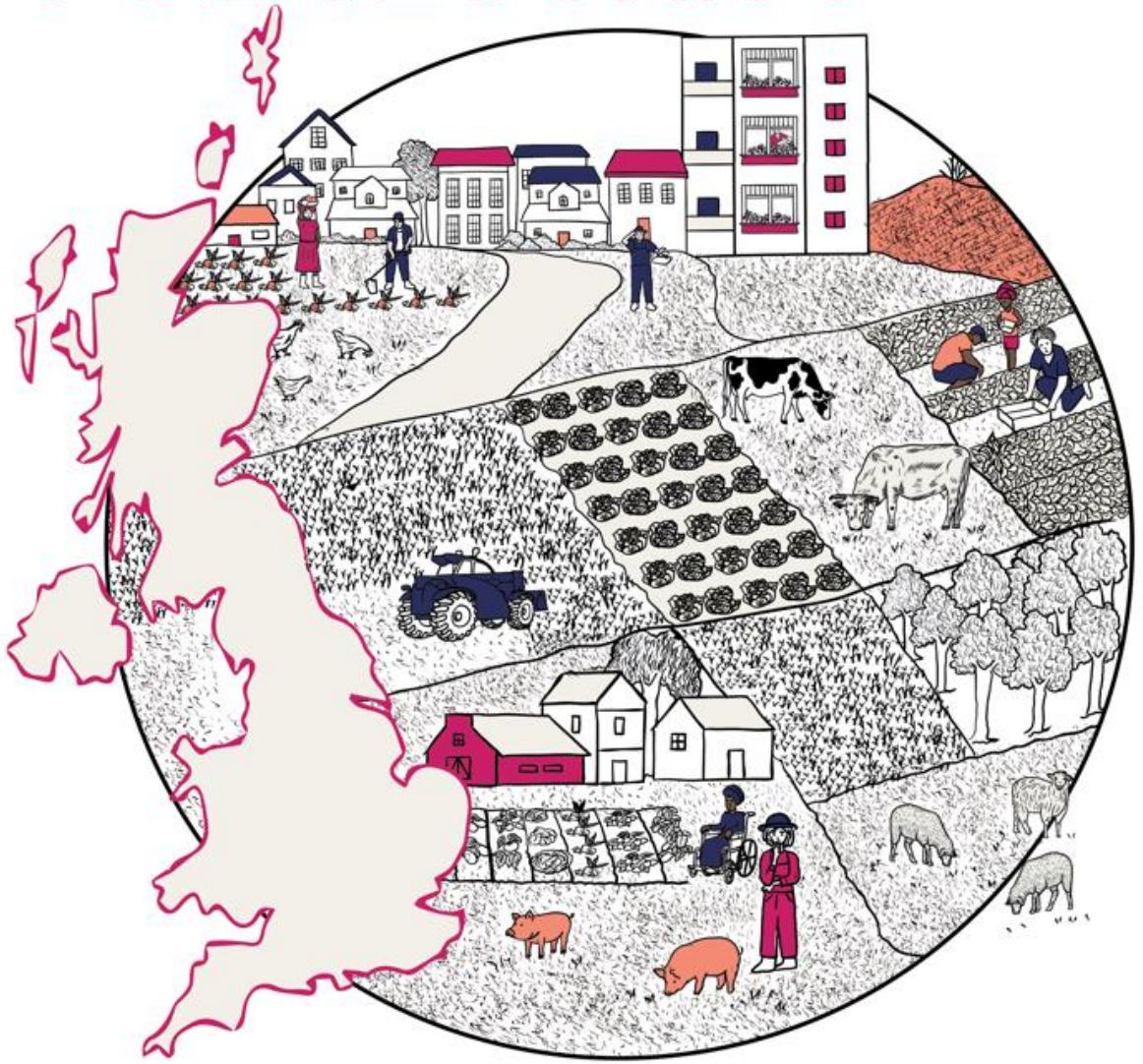
Need for land-use strategy/incentives to ensure the right land is used in the right way

Food insecurity and inequality growing: how to mitigate by producing more food, more cheaply in a crisis?

How to drive changes in values and disrupt incumbent ideology to get off this pathway?

SCENARIO C

‘SELF-SUFFICIENCY FOR SECURITY’



A geopolitically unstable, regionalised world, which is more circular and sustainable due to “waste not, want not” poverty

- Grim, poorer world, more circular, low waste systems, mixed farming, more self sufficiency, less trade, some tech but not shared. Ag policy based on nutrition needs. Food security (resilience in supply) more important than mitigation.
- *Net zero largely arises from lower consumption, from increasing adaptation (e.g. improved soil carbon to build soil fertility) and reducing waste.*

What would be needed?

- Incentives/capacity building for urban and small-scale market gardens/allotments; cooking skills
- **Circularising farming and developing low input, circular, diverse farm systems (with green manure not synthetic fertilizer)**
- Any new tech primarily developed from UK science base (legumes, protein extraction from grass for chicken feed etc)
- Agriculture for local consumption for nutrition security (not for e.g. exports, feed or whisky)

SCENARIO D

‘THE RIGHT TO FOOD’

A geopolitically stable world, global, with economies built around “green growth”

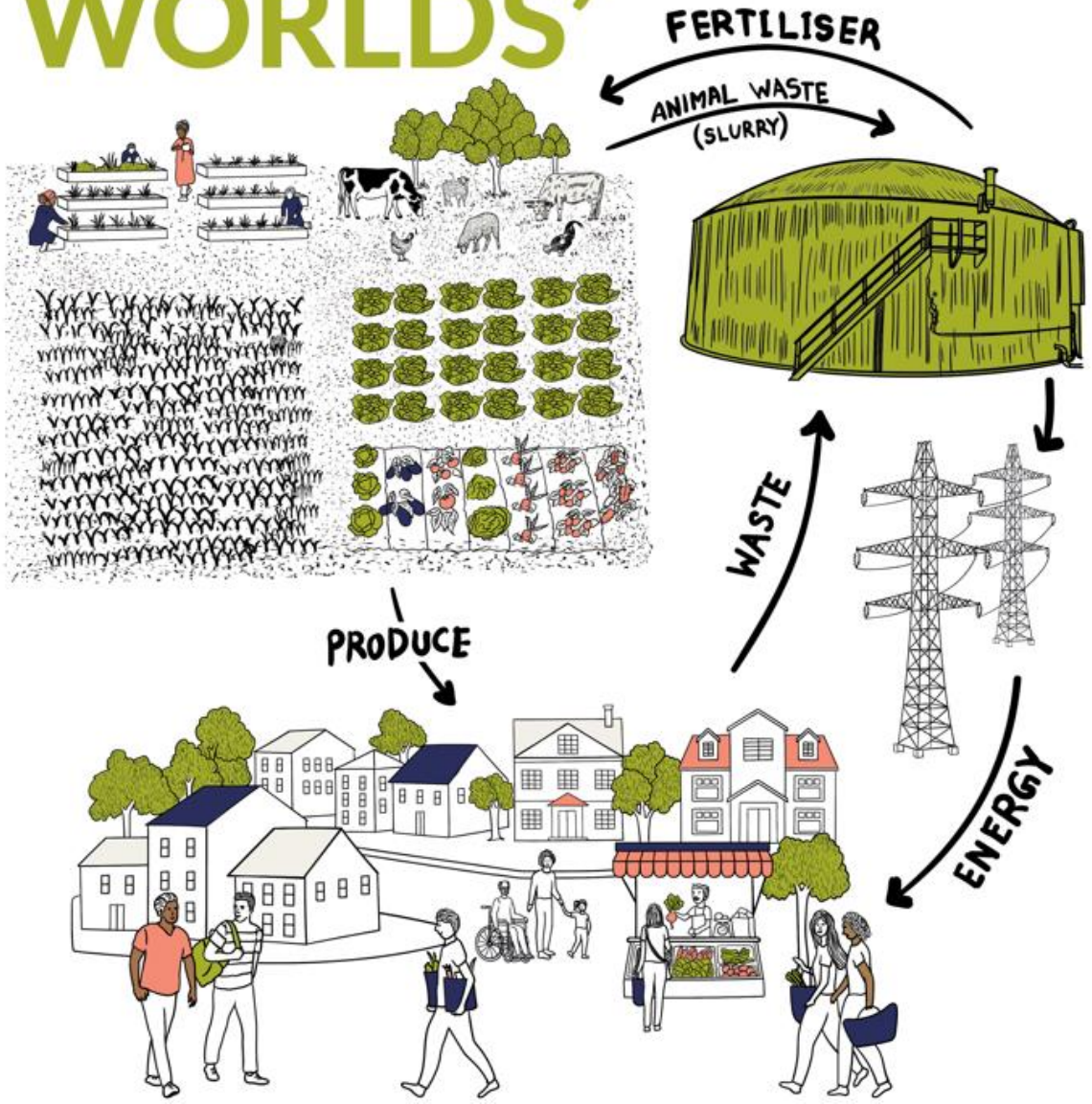
- UK farmscape: sustainable intensification and land sparing; green fertilisers and agro-ecologically intensive. Processed foods, but with focus on nutrition. More horticulture, less meat production. Tech-rich.
- About maximising yields, sustainably
- *Net zero arises from “really sustainable” intensification, dietary change (less meat, more veg) and land sparing*

What would be needed?

- Need for incentives/capacity growth in urban and small-scale market gardens/allotments;
- *Really* sustainable intensification: how to **maximise yields in *intensive* land-sparing,** not sharing, agro-ecological systems e.g. **Green fertilisers and biological/Integrated pest control**
- Carbon storage in former pastureland – rewilding – but how and where at least cost
- *How to drive changes in values and disrupt incumbent ideology to get to this pathway?*

SCENARIO B

'CIRCULAR WORLDS'



A geopolitically stable, globalised, circular and sustainable world

- More whole foods, diverse, mixed farming landscapes, land sharing approaches, local food networks. Tech-rich.
- About growing "enough" not maximising productivity
- *Net zero arises from changes in values (focus on well-being), diets, and agricultural systems.*

What would be needed?

- Significant change in behaviours/farming/lifestyle to get here – need for capacity building and changing incentives
- More research on **farm systems needed, and tech to produce sufficient yields on diverse, mixed, circular, agro-ecological farms**
- *How to drive changes in values and disrupt incumbent ideology to get to this pathway?*

TUNA

CONCLUSIONS

Food x climate x politics = an uncertain future

Food system transformation is needed for human health, to protect biodiversity and reduce climate change impacts

- **Change is all around us, and food system transformation is, in the long term, inevitable – to build resilience, sustainability and healthy diets – but it may be a rocky ride**
- **Food is part of national security: taking a 'security lens' (instead of a 'maximise productivity' lens) creates more space for driving food system transformation ("work for the best, plan for the worst")**
- **There is often an overly strong focus on technology to "unlock change" but systemic change is unlikely to arise unless citizens, farmers and investors enable political change that changes the "rules of the game"**
- **This, in turn, may be driven by volatility from climate change creating more geo- and domestic political issues**
- **In many plausible futures, agro-ecological farming approaches and dietary change are more desirable, if not central to them (for ecological, economic and security perspectives). Its not about growing more of the same with less impact.**

Leverage points to unlock systems-level change

Leverage point	Example levers
Changing the rules of the market	Regulate/tax harmful effects
	Reform subsidies
	Stimulate demand for the "better"
	Make change less risky for markets
	Increase competition/reduce power of big businesses
Build market transparency	Increase disclosure
	Limit greenwashing
	Limit lobbying power
Unlocking political change	Build citizen pressure for change
	Foster ambition for change internationally (e.g. trade and COPs)
	Build social safety nets
Mainstreaming systems-level approach to change	Create a clear vision
	Build whole-of-govt approach
	Use "true-cost" accounting

But most of these politically difficult today

Change requires that the system be disrupted *endogenously* (changed politics) or *exogenously* (by events) to open the political space – *and that might be soon*

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Thank you!

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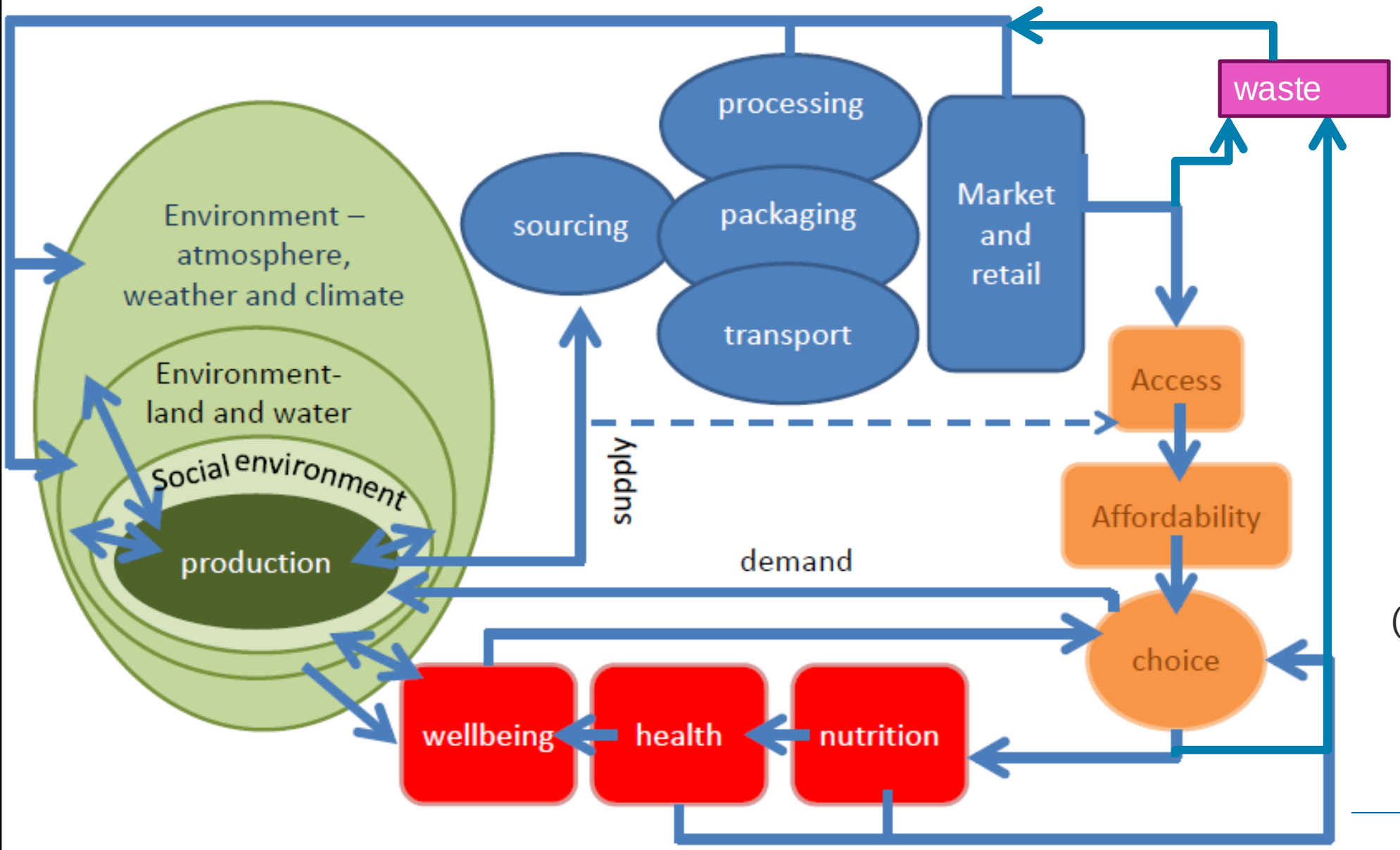

The food system is a complex system: feedbacks, loops and connections…and no overall governance: the outcomes (food supply, food security, environmental impacts) arise from billions of individual decisions by food system actors (policy, farming, industry, consumers)

Different futures, different food systems

Free trade, global markets

Local or regional markets

Commodity crops, large scale
Biotechnology and biofortification
Ultra-processed foods
Long supply chains
Lots of robotics

More varied diets to provide nutrients
More varied farming systems, smaller scale
Less agricultural efficiency and more system efficiency
Low waste
Whole foods, cooked at home
Short supply chains