The future of food systems: where does science fit in?

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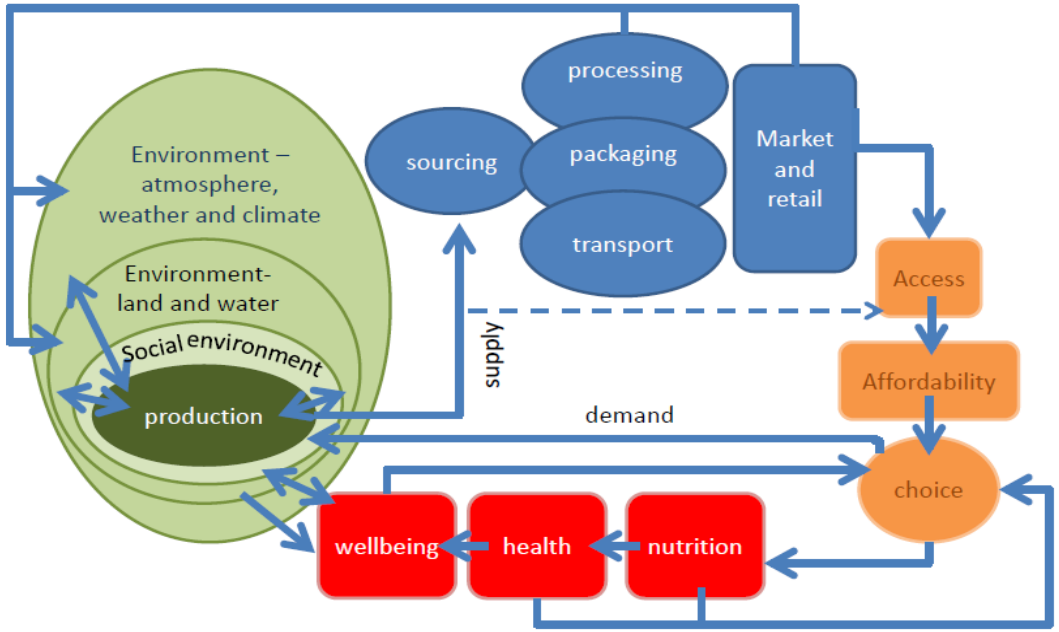
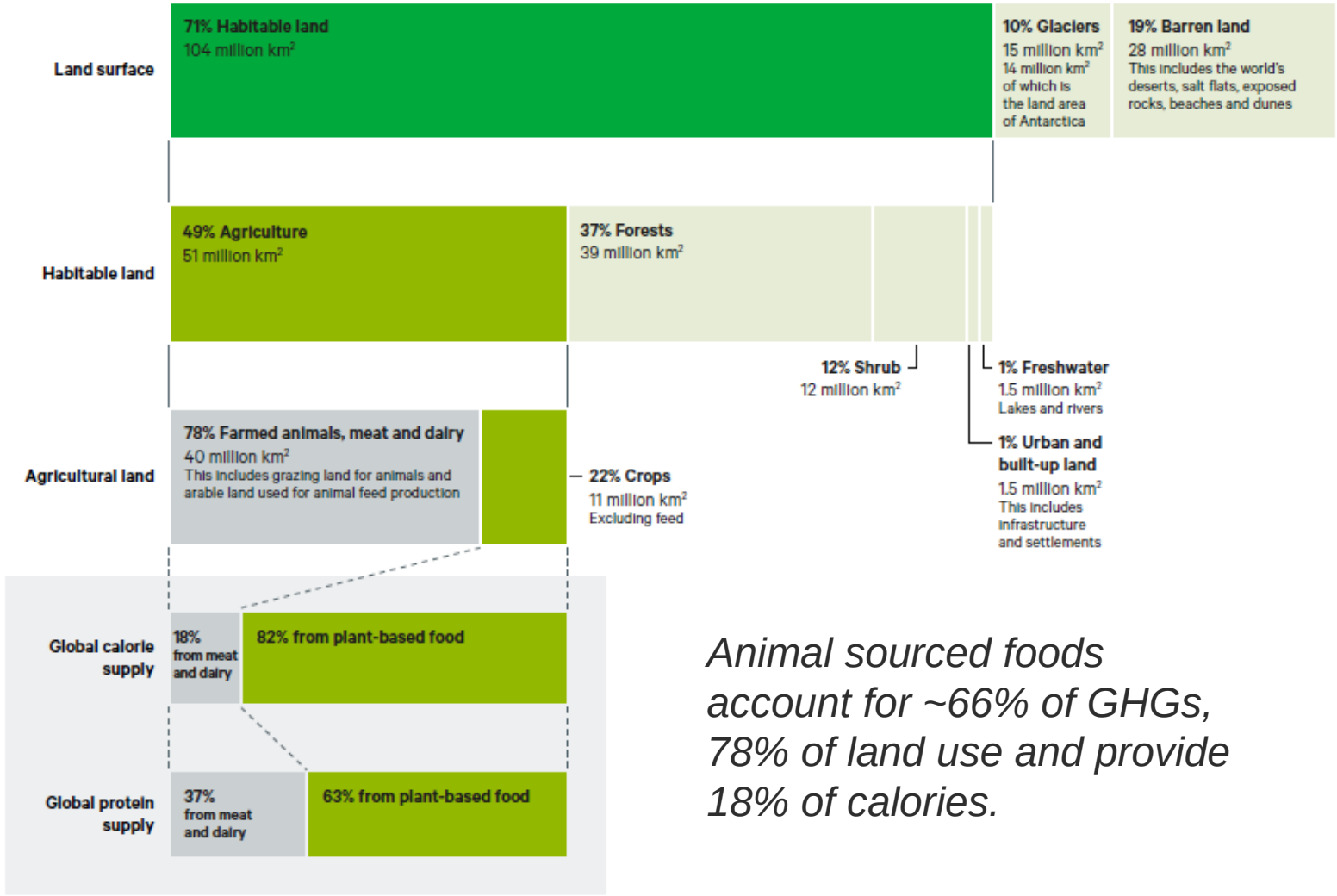


Food-systems are unsustainable

- **Food systems are a major driver of climate change and ecological degradation.**
- **Conversion of native habitats/ecosystems to farmland.**
- **Creation of monocultural landscapes (with little space for nature).**
- **Pollution from pesticides, fertilizers and manure.**
- ***Poor diets are now the no 1 cause of global ill health and death*** ***(p.a. more than 40% of total COVID)***



Animal sourced foods account for ~66% of GHGs, 78% of land use and provide 18% of calories.

WHY ARE WE WHERE WE ARE TODAY?

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

A systems approach highlights the Jevon's paradox

William Stanley Jevons

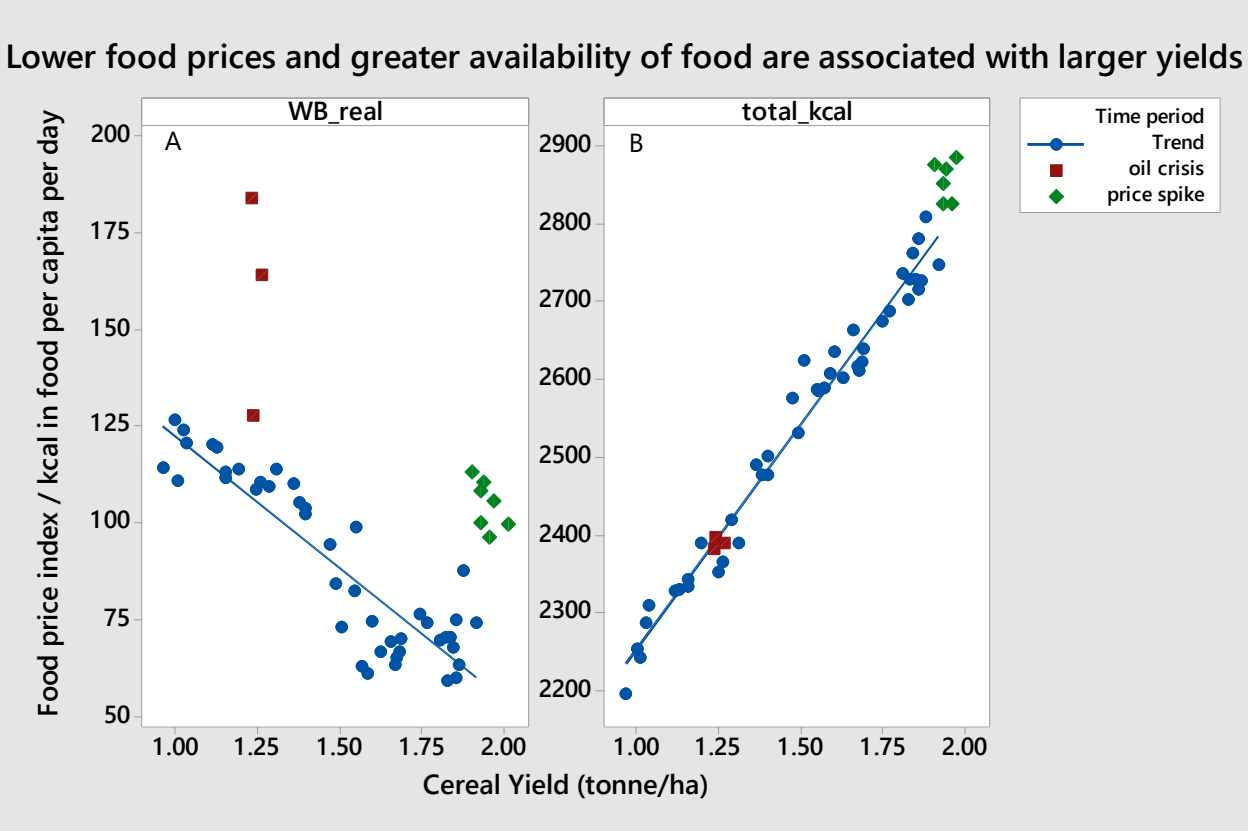
*The paradox: Increasing production efficiency **increases** demand (through lowering prices)*

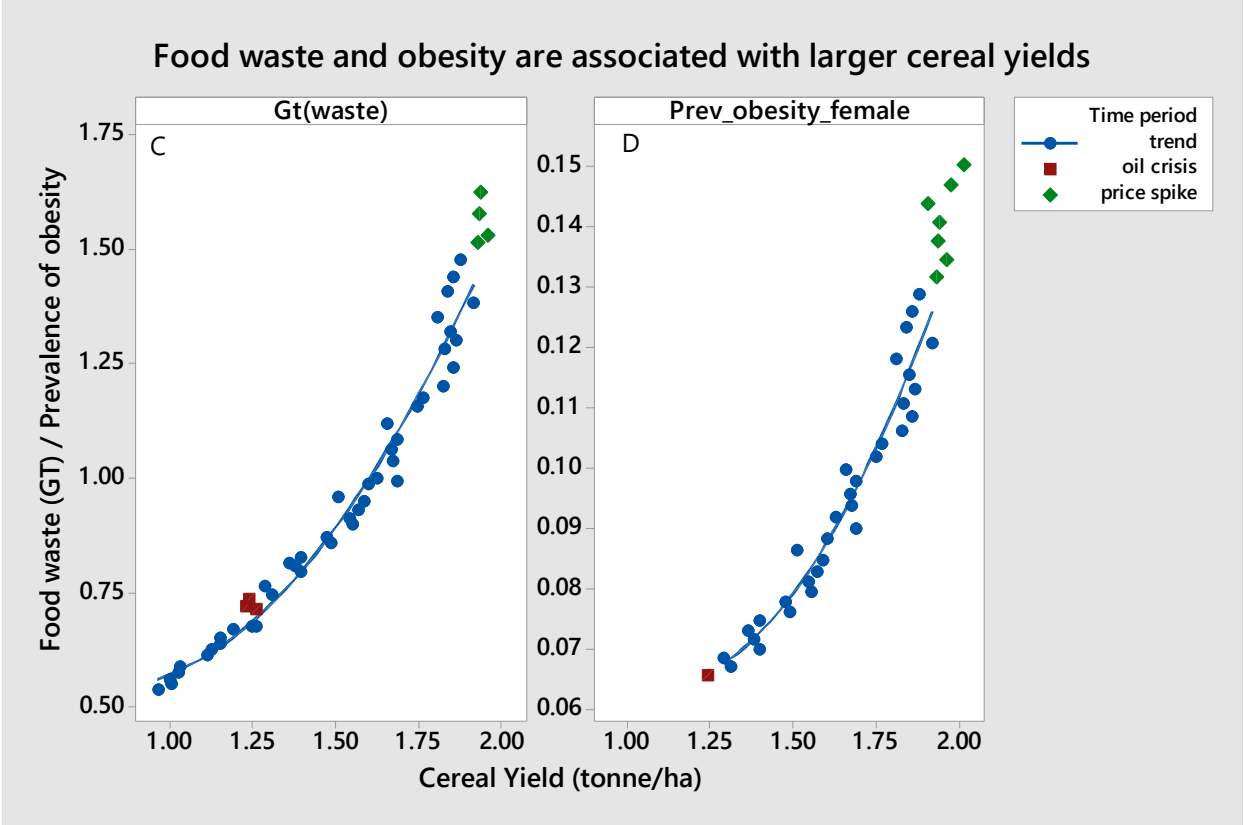
Over the last 60 years, we have reduced the price of food and increased its availability

As a result, collectively we waste and overeat more, and political dialogue is about producing more food

e.g. through intensive production, grain prices are low. So low, that across the EU, over 60% of all production is fed to livestock, reducing the price of meat.

Is cheaper food a public good? The experience over 60 years





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

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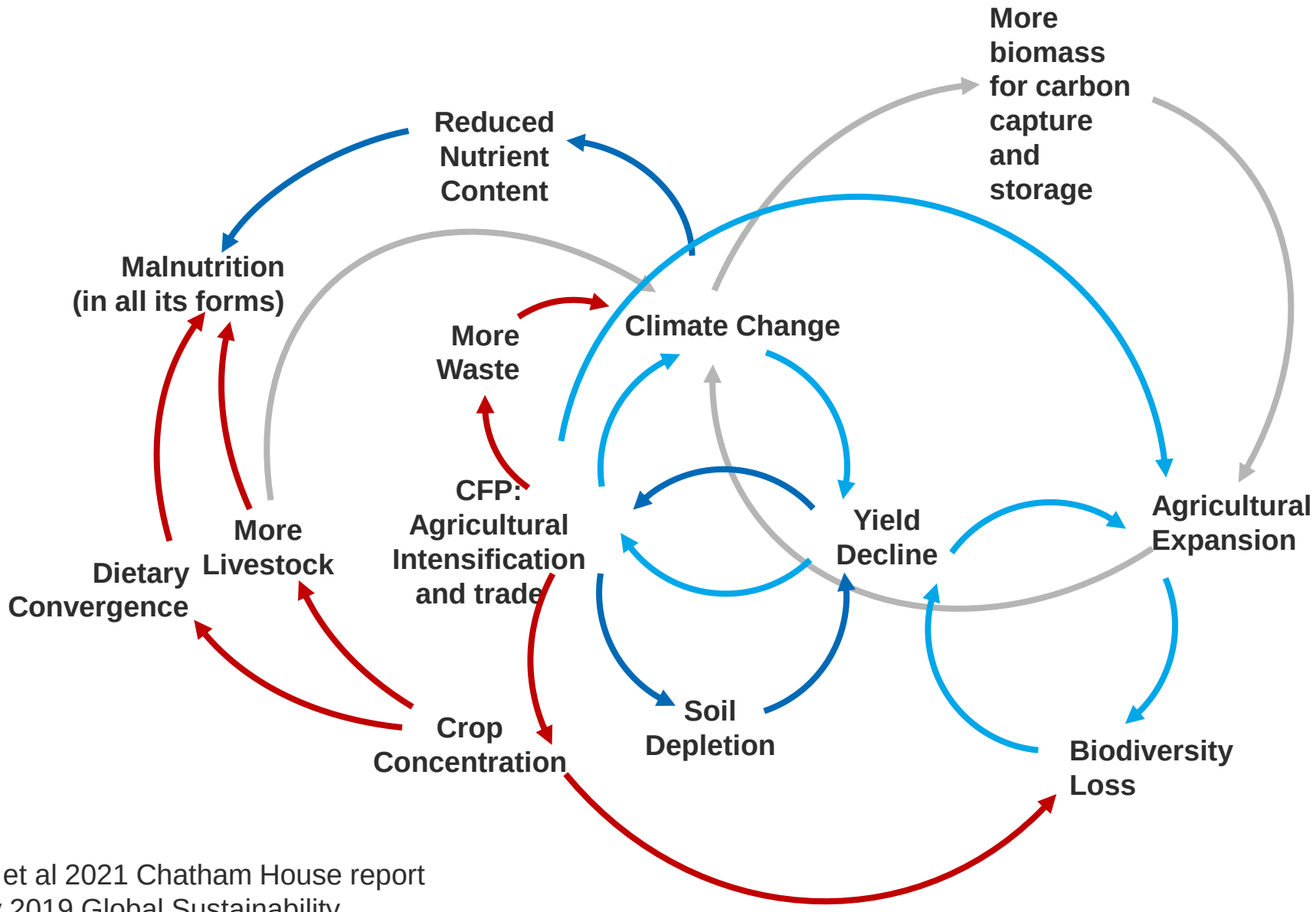

Source: Benton et al 2021 Chatham House report
Benton & Bailey 2019 Global Sustainability

“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

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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

Core issues at the heart of the debate

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

Contrasting visions of “sustainable agriculture”: is beef bad? (Schader C et al. 2015 J. R. Soc. Interface 12: 20150891)

Maximising production efficiency (Version1)

- Sustainable intensification (maximising agricultural output efficiency on farm)
- Dietary change devolved to “consumer choice” based on LCA hierarchy (beef to chicken to beans), eating from “more efficient” intensive systems

Maximising systemic efficiency (Version2)

- Integrated agricultural landscapes (land sharing) – diverse, heterogenous, vital role for ruminants
- Dietary change based more on market restructuring to encourage “less but better” (less beef, but beef from agro-ecological approaches, avoiding grain-fed livestock)

DESPITE TALK OF THE NEED TO TRANSFORM, THE FOOD SYSTEM IS LOCKED-IN, IN 3 WAYS

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

1. 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

2. Market concentration

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

Competitors and disruptors face significant barriers to entry

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

Environmental impacts not costed

Transformative change is perceived as prohibitively challenging, politically and economically

3. Path dependencies

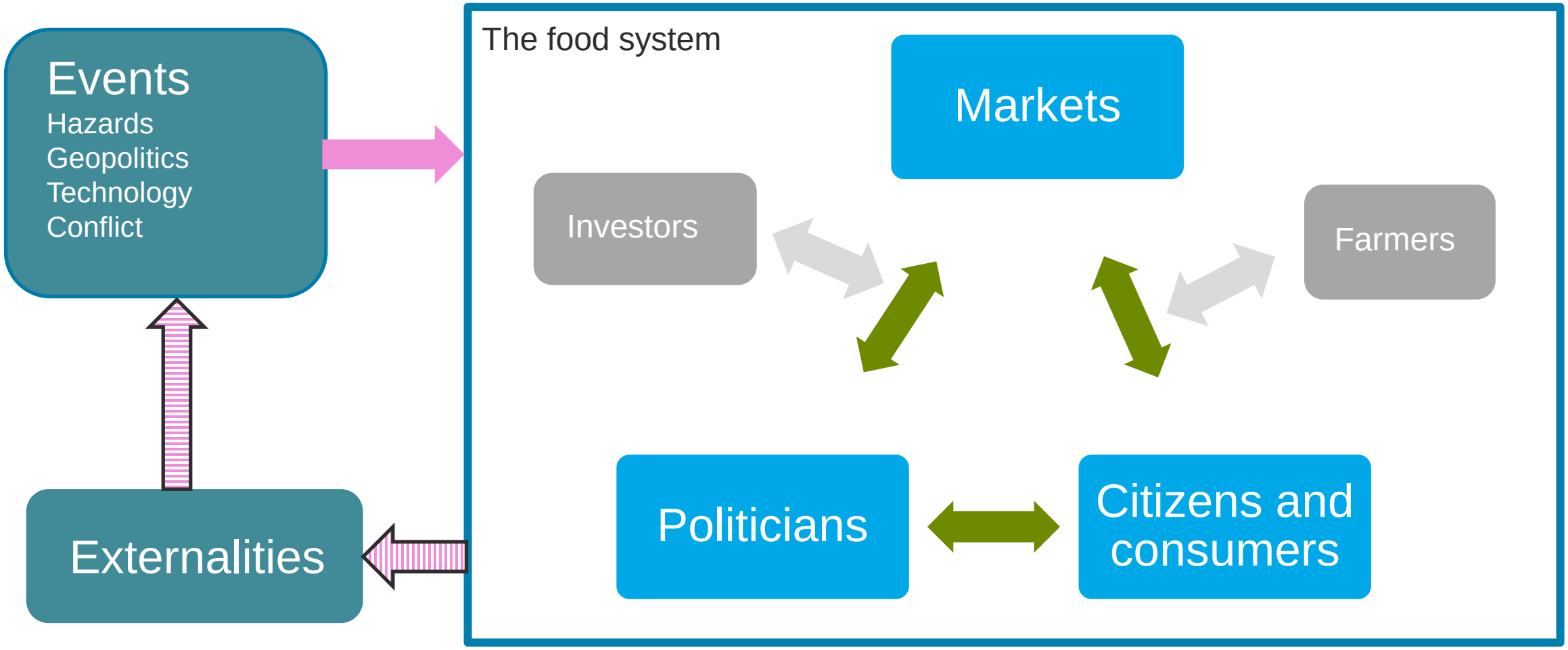
So much money has been spent by business interests, it is difficult to change tack

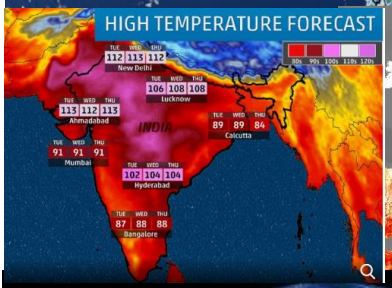
Near-monopolies exert big price pressures

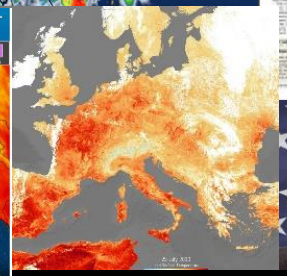
Innovation is driven by incumbents and focused on efficiency improvements to BAU

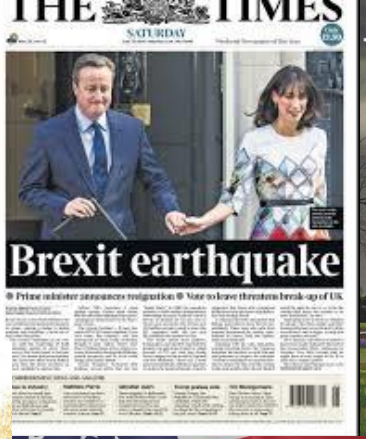
WHO OR WHAT WILL SHAPE THE FUTURE?

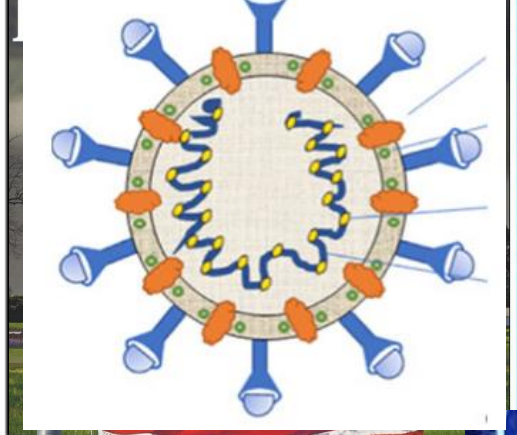
What shapes the future?

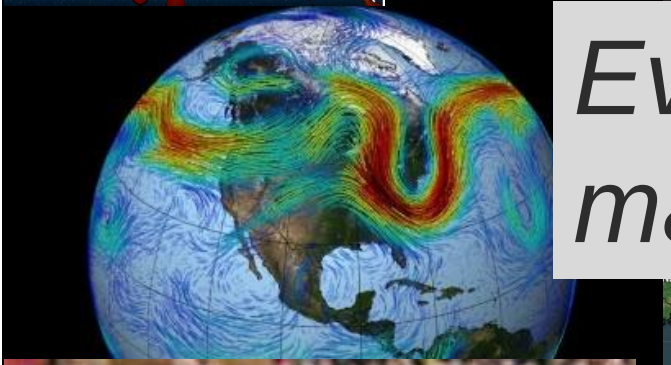


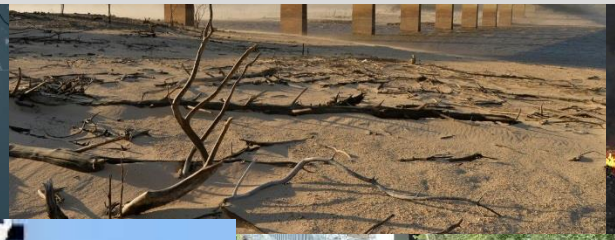


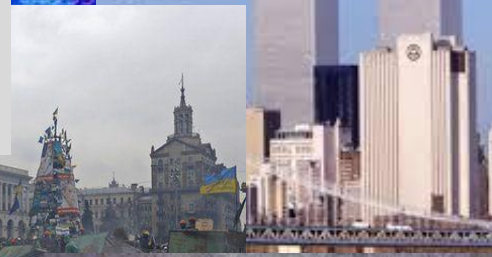


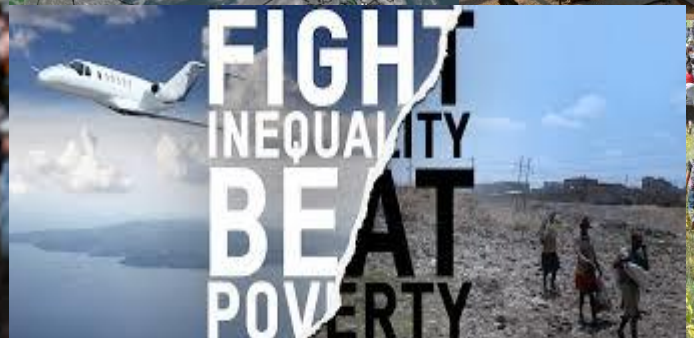






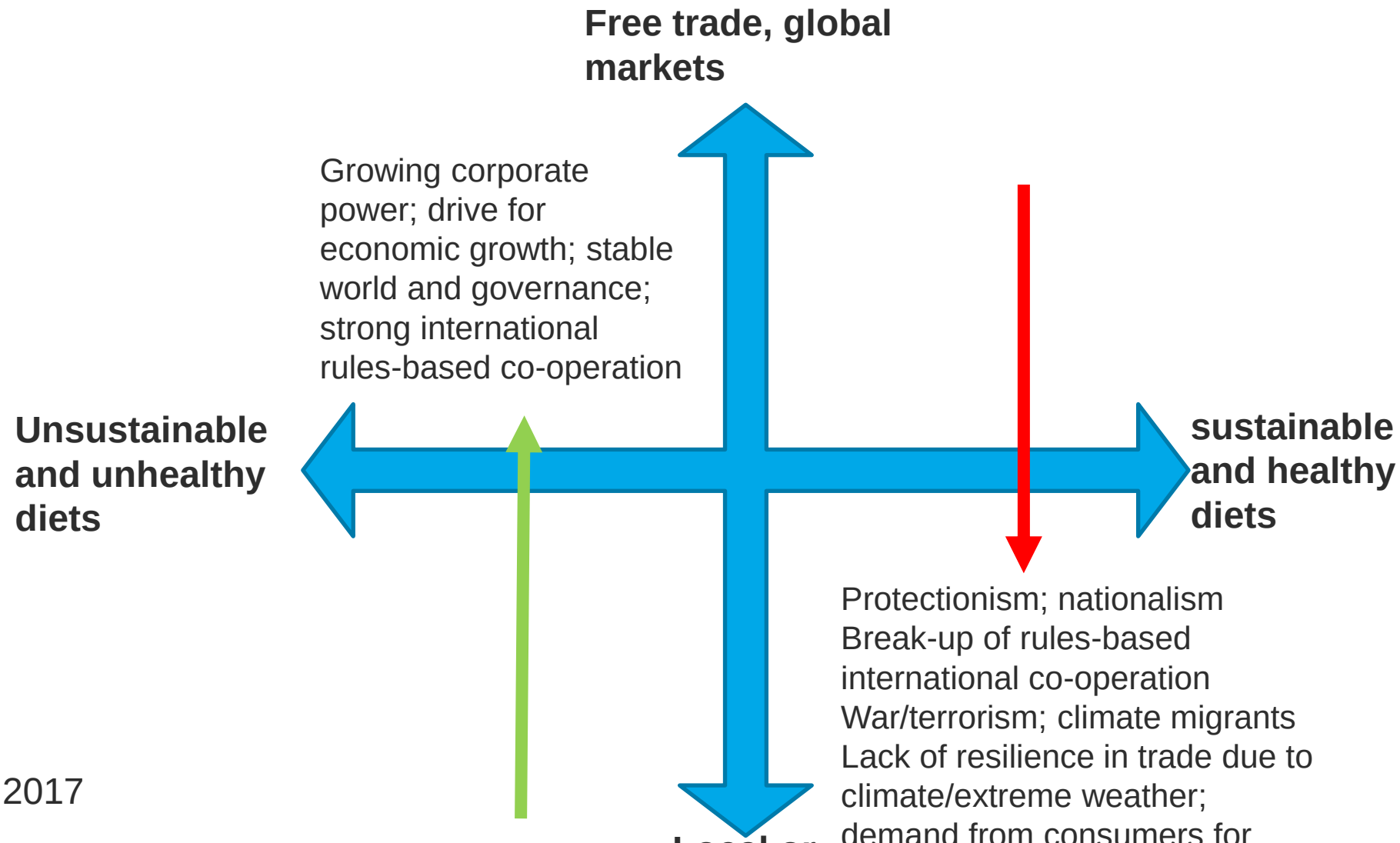






Events happen that reshape markets, politics and attitudes

Future of food systems

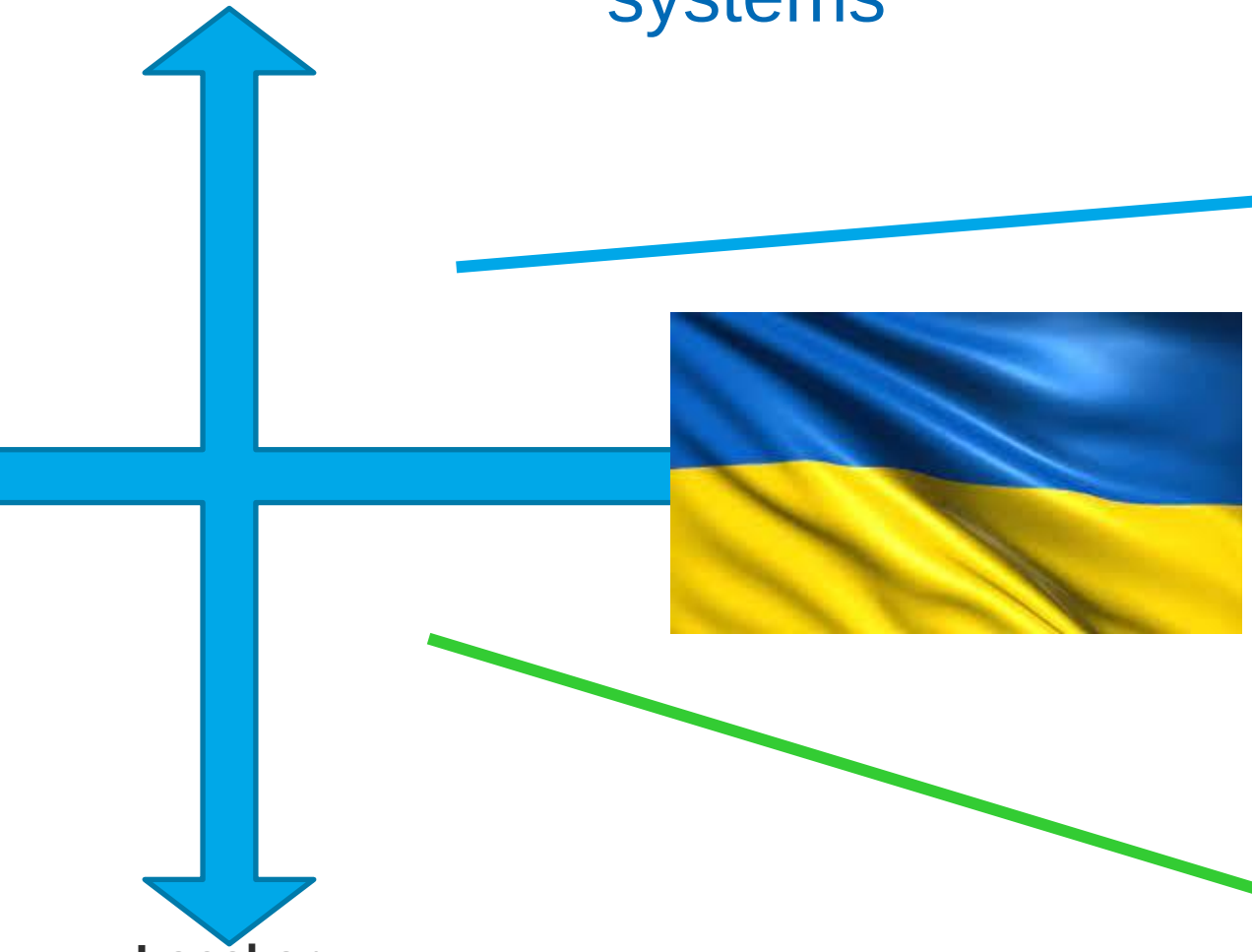


2017

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

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

Summary of research needs in 4 scenarios for 2050 UK food system

A: unstable world, globalised, economic growth is key (BAU)

- *How to drive changes in values and disrupt incumbent ideology to get off this pathway?*
- **Resilience building**, and how to maximise mitigation when building adaptation? **Tech for RUE, yield maximisation**
- Need for land-use strategy 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?

B: geopolitically stable, globalised, circular and sustainable

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

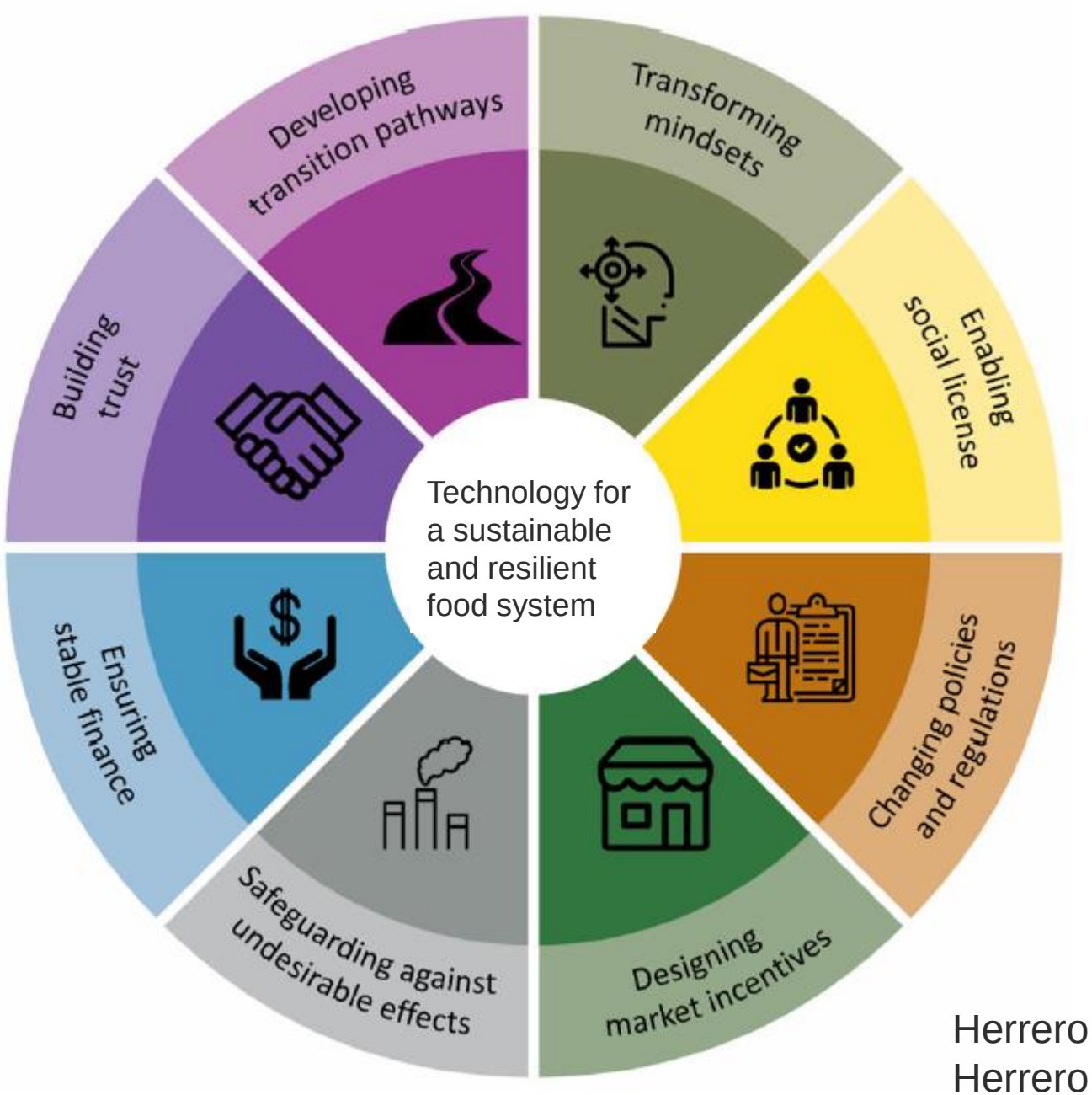
C: unstable world, regionalised, circular economy driven by need for low waste

- Capacity growth 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 whiskey)

D: geopolitically stable world, global, economies built around "green growth"

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

CONCLUSIONS



- **Systemic change is not driven by technology alone but by development of "socio-technical bundles" which require significant change across multiple social, economic and governance arenas**
- **There are no silver bullets: new technologies likely have positive and negative effects depending on the context**

Herrero, M, et al. 2020. *Nature Food* 1: 266–272.
Herrero, M, et al. 2020. *Lancet Planetary Health*
Barrett, C, et al. 2020 *Nature Sustainability* 3: 974-976

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

- **Often there is 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" and unlocks the lock ins**
- **Structural market change (trade, subsidies, research, taxes, availability, incentives, public procurement, education) is needed to invert the business model of large agri-business**
- **Real, systemic change requires concentrated pressure on a smaller number of leverage points. Such pressure is as likely to come from "events" as from within**
- **Science and technology are key to whatever future, but the technology needs depend on how the future develops. Today's perceived needs of agriculture (around sustainable intensification) may not persist.**

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Thank you!

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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
	Build social safety nets
Mainstreaming systems-level approach to change	Create a clear vision
	Build whole-of-govt approach
	Use “true-cost” accounting

Summary characteristics of 4 scenarios for 2050 UK food system

A: unstable world, globalised, economic growth is key (BAU)

- 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.*

B: geopolitically stable, globalised, circular and sustainable

- More whole foods, diverse, mixed farming, land sharing approaches, local food networks. Tech-rich.
- About growing "enough"
- *Net zero arises from changes in values (focus on well-being), diets, and agricultural systems.*

C: unstable world, regionalised, circular economy driven by need for low waste

- 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.*

D: geopolitically stable world, global, economies built around "green growth"

- UK farmscape: sustainable intensification and land sparing; green fertilisers and agro-ecological 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*