Resilience (and sustainability) in food systems

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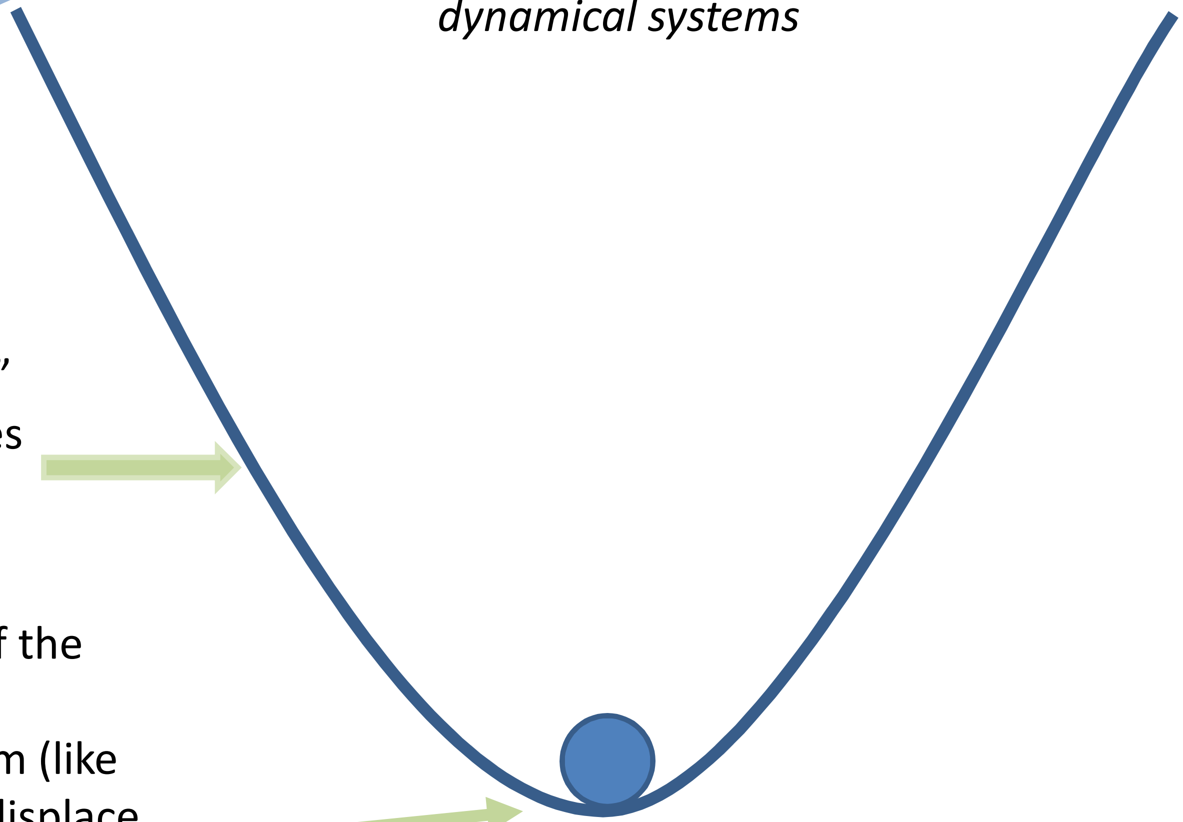
INTRODUCTORY CONCEPTS: RESILIENCE 101

Resilience: recovery from “shock”

Resilience is the speed which the system returns to stability – and depends on depth and width of cup

“Cup and ball” depiction of dynamical systems



Cup defined by “slow” or controlling variables (e.g. climate, soil “health”)

Ball represents state of the system (e.g. yields)

- Shocks to the system (like extreme weather) displace the ball
- Negative feedbacks return it to stable state

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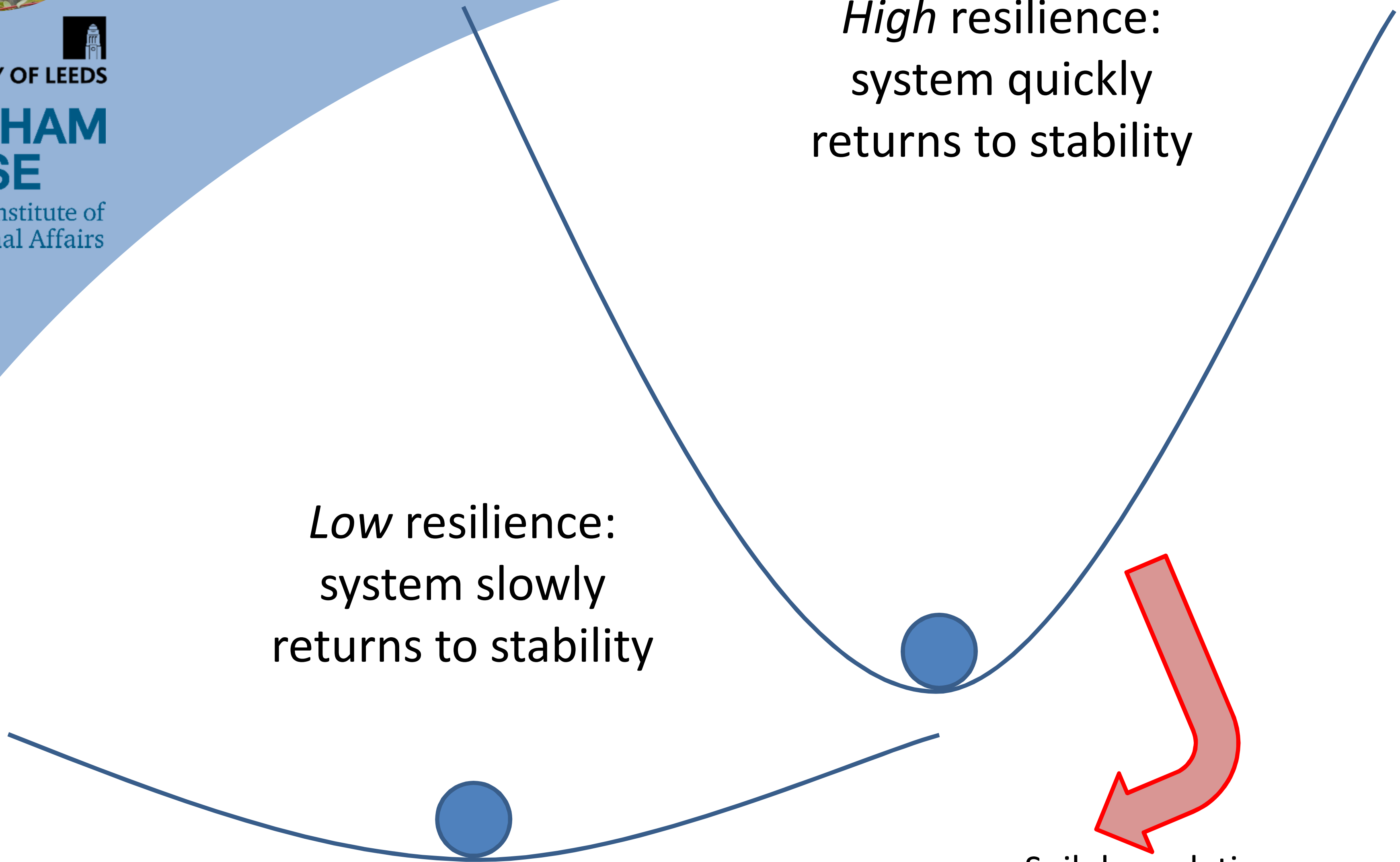
Resilience: recovery from "shock"



Resilience and tipping points

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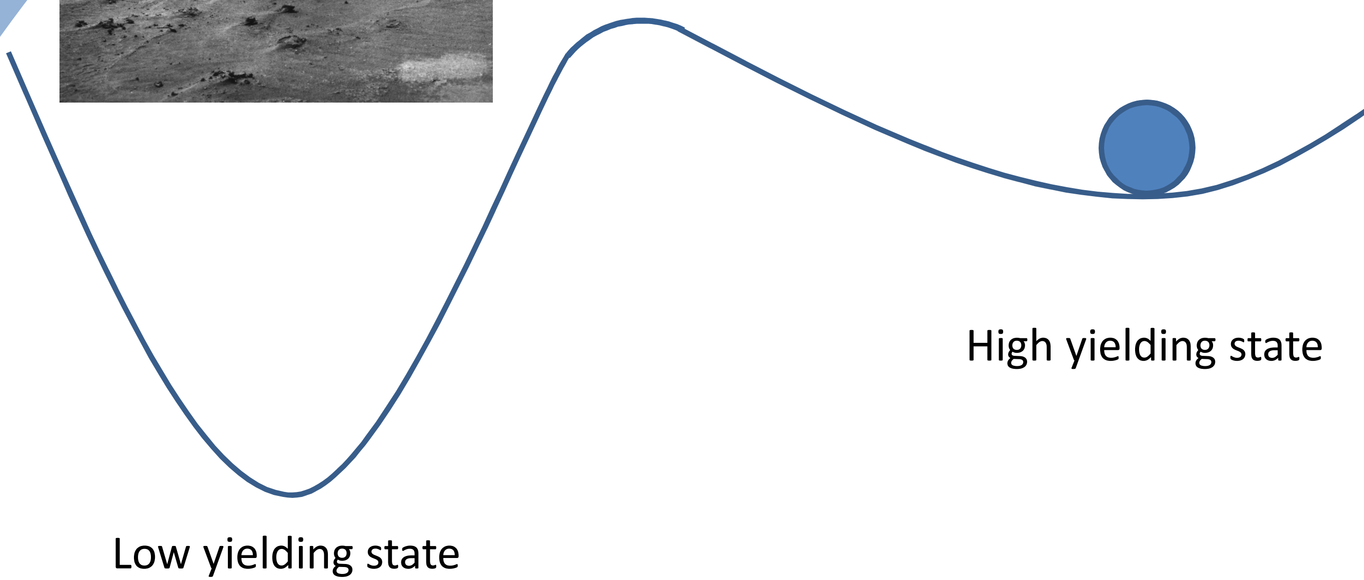
Systems with low resilience can "tip" into alternative stable states – especially if shocks are getting bigger



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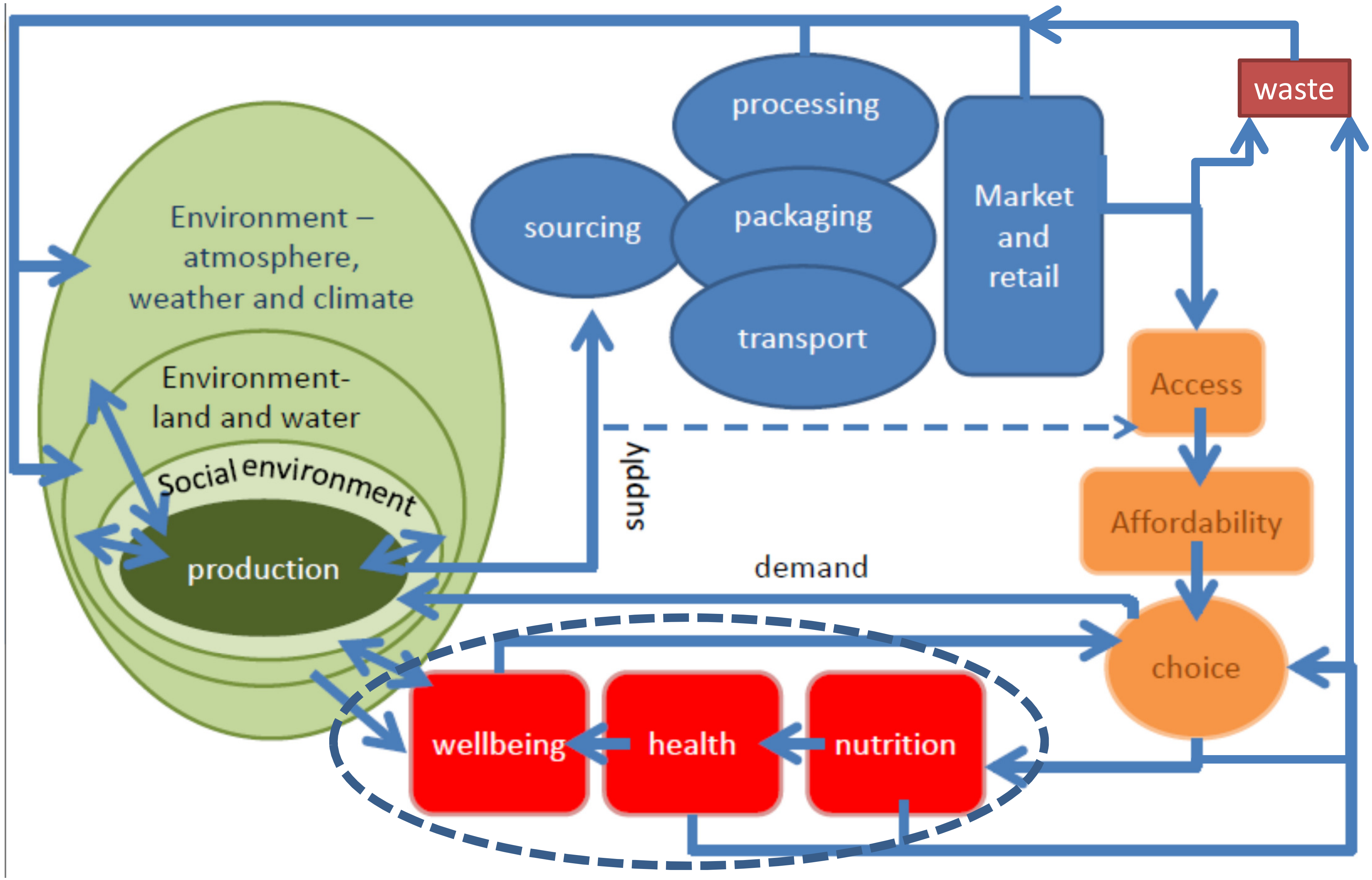
POINT 1: RESILIENCE OF THE FOOD SYSTEM IS NOT THE SAME AS RESILIENT AGRICULTURE

The food system



As yields grow, waste grows faster

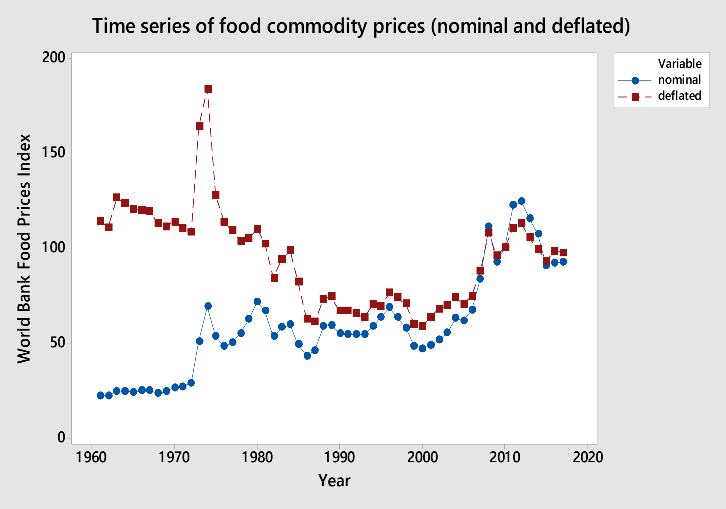
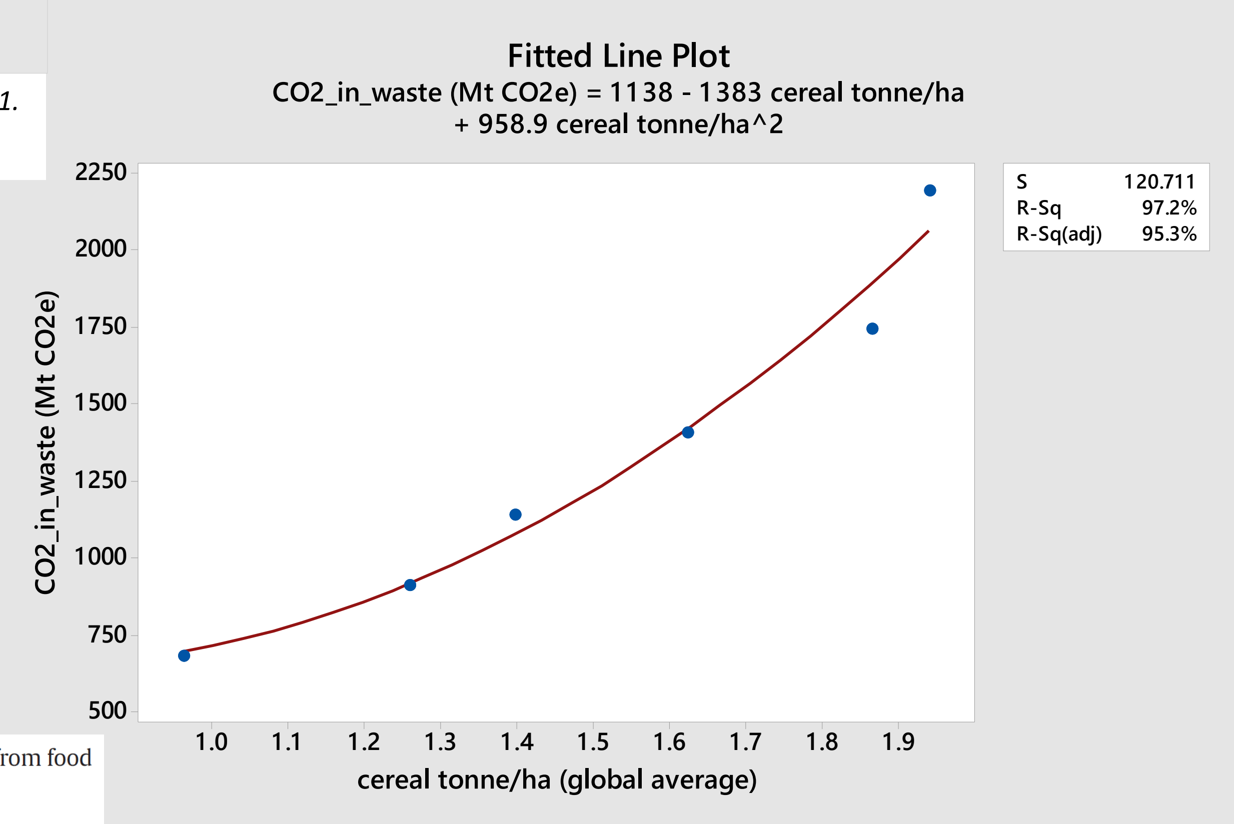


Fig 2.19. Nominal and Real global food prices since 1961. Data from World Bank http://data.worldbank.org/

making food cheaper embeds waste as "economically rational behaviour"



A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain

Stephen D. Porter [a,*], David S. Reay [a], Peter Higgins [b], Elizabeth Bomberg [c]

[a] School of GeoSciences, University of Edinburgh, Edinburgh EH8 9XP, UK
[b] Moray House School of Education, University of Edinburgh, Edinburgh EH8 9JX, UK
[c] School of Social & Political Science, University of Edinburgh, Edinburgh EH8 9LD, UK

Science of the Total Environment 571 (2016) 721–729

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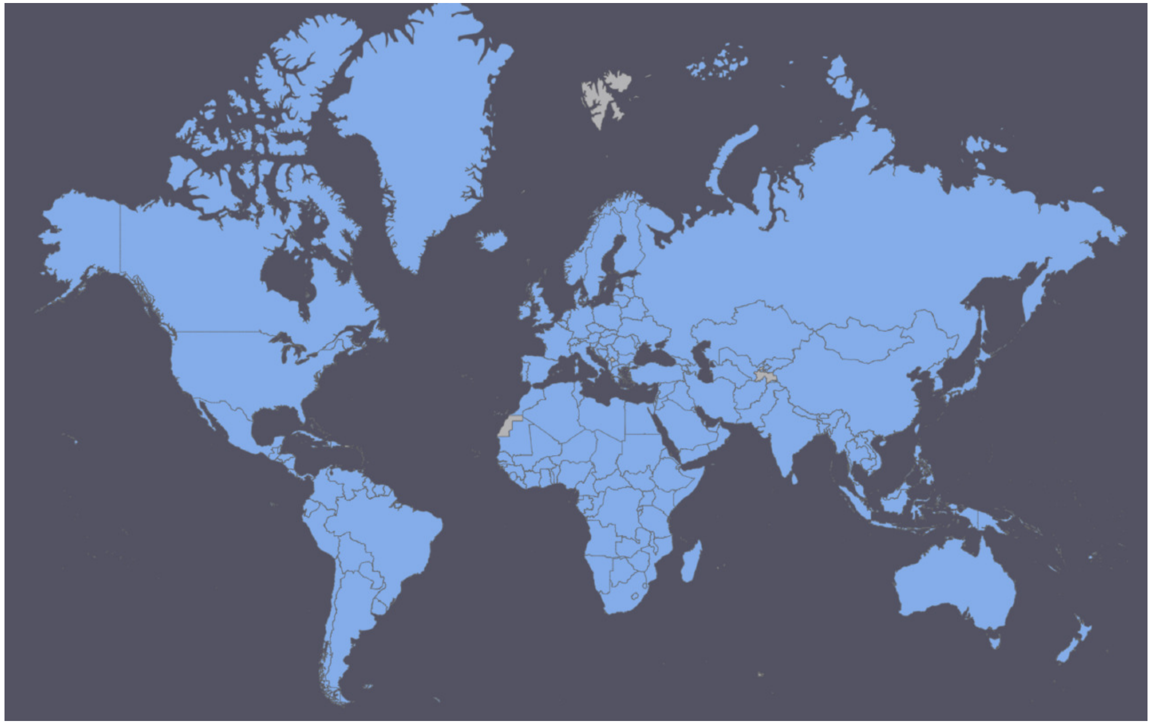
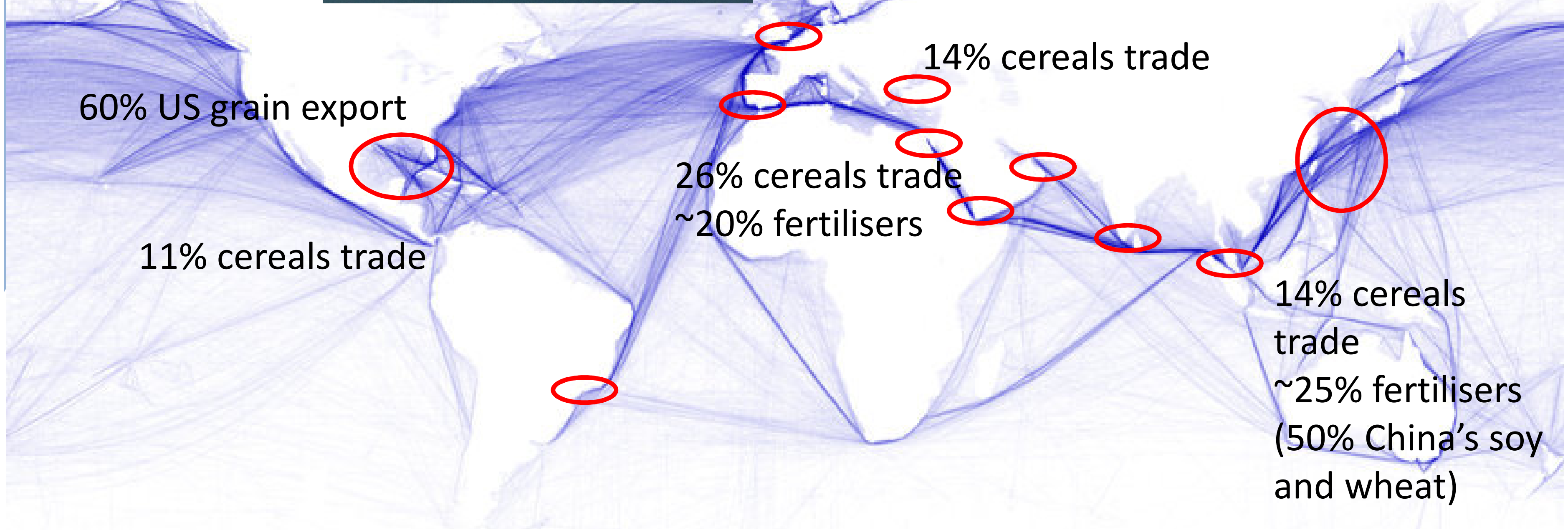
Food systems are spatial

…so food system resilience depends on more than local agricultural resilience

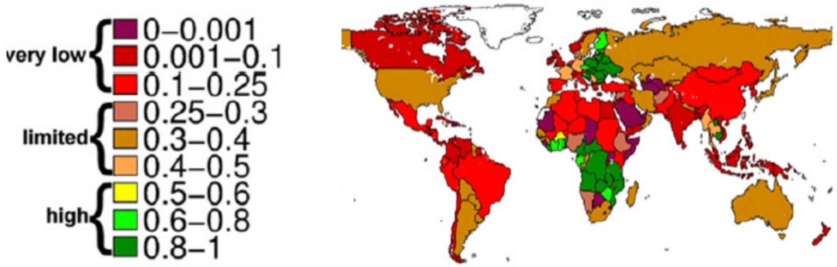


The UK as an example of a food system: the countries in blue exported food to the UK 2011-2016

Food system resilience requires resilient transport infrastructure



https://www.chathamhouse.org/about/structure/eer-department/vulnerabilities-and-choke-points-global-food-trade-project



Environ. Res. Lett. 11 (2016) 055008

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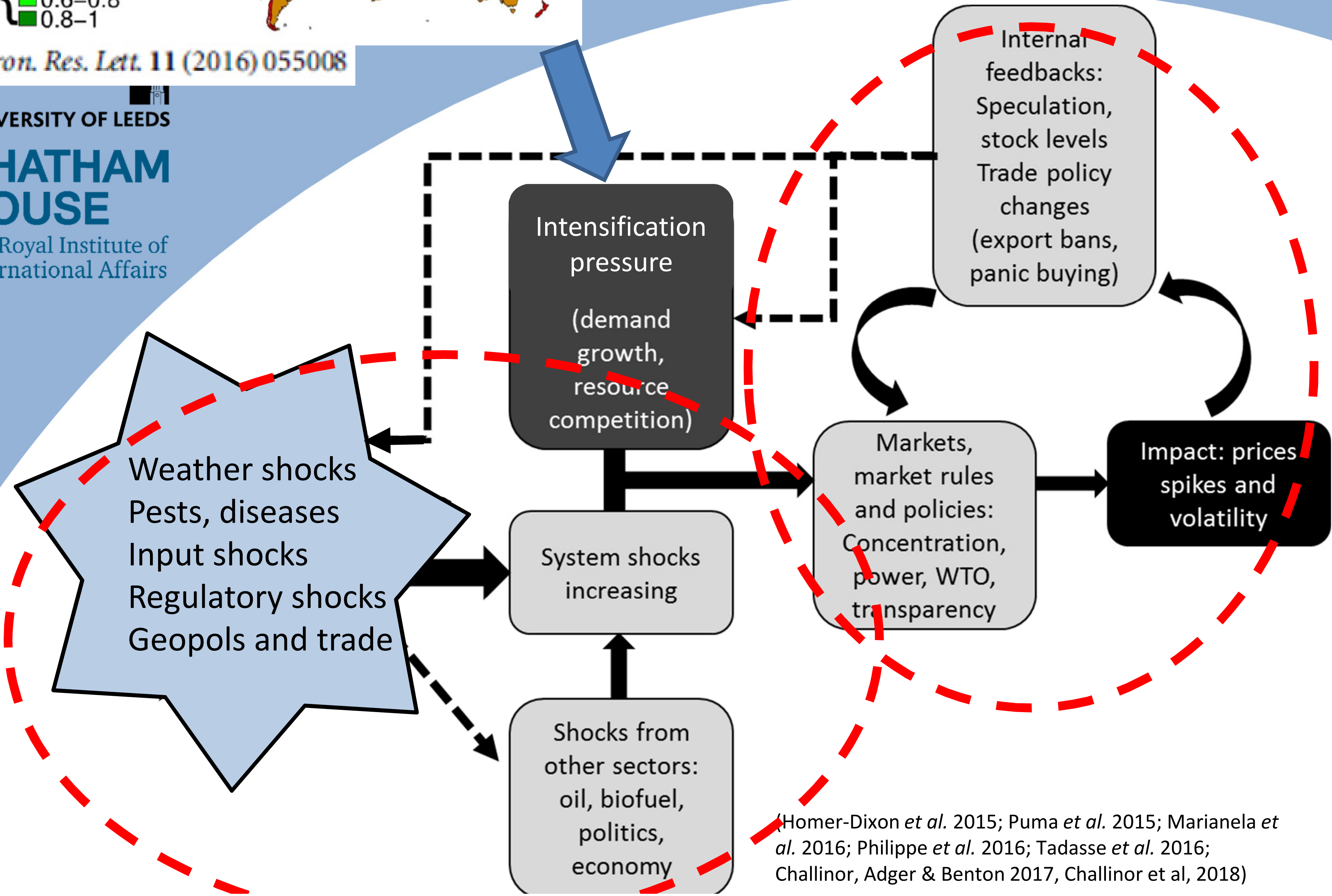
Food system resilience depends on many factors



(Homer-Dixon *et al.* 2015; Puma *et al.* 2015; Marianela *et al.* 2016; Philippe *et al.* 2016; Tadasse *et al.* 2016; Challinor, Adger & Benton 2017, Challinor et al, 2018)

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POINT 2: RESILIENCE IS NOT ALWAYS GOOD

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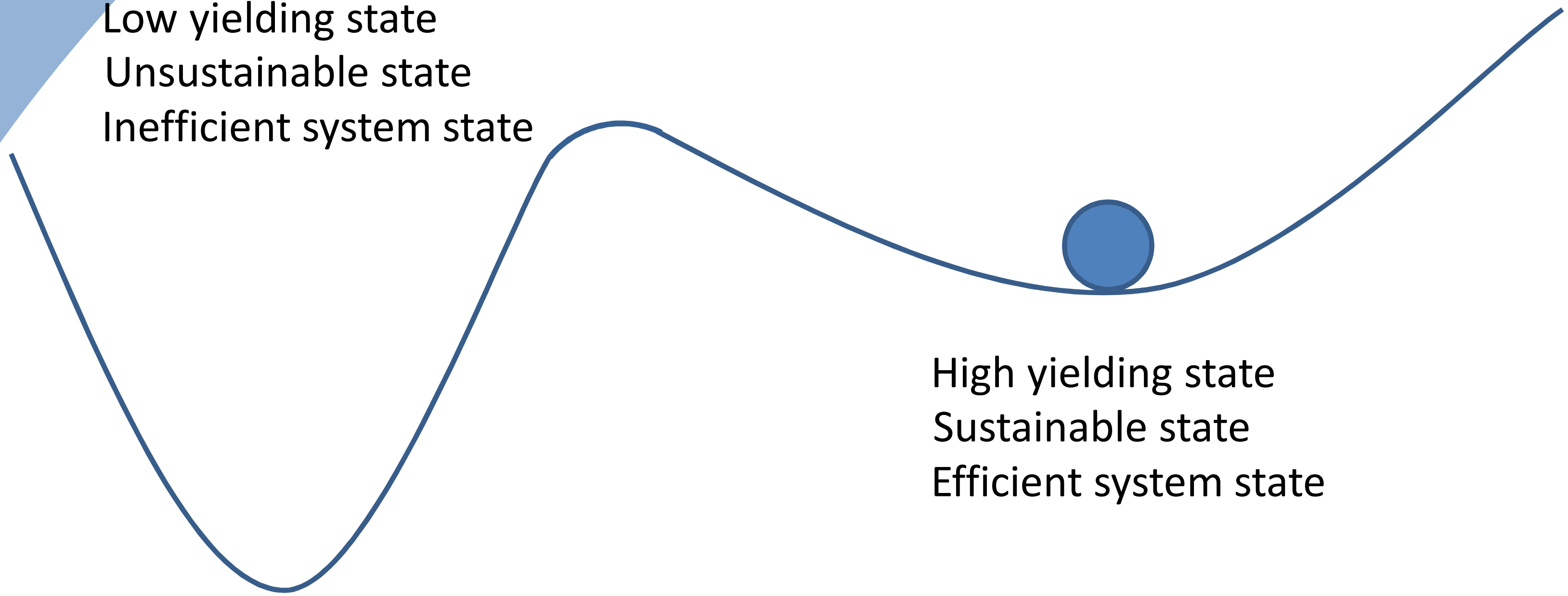
"Lock-in" or "inertia" can be the *wrong sort* of resilience



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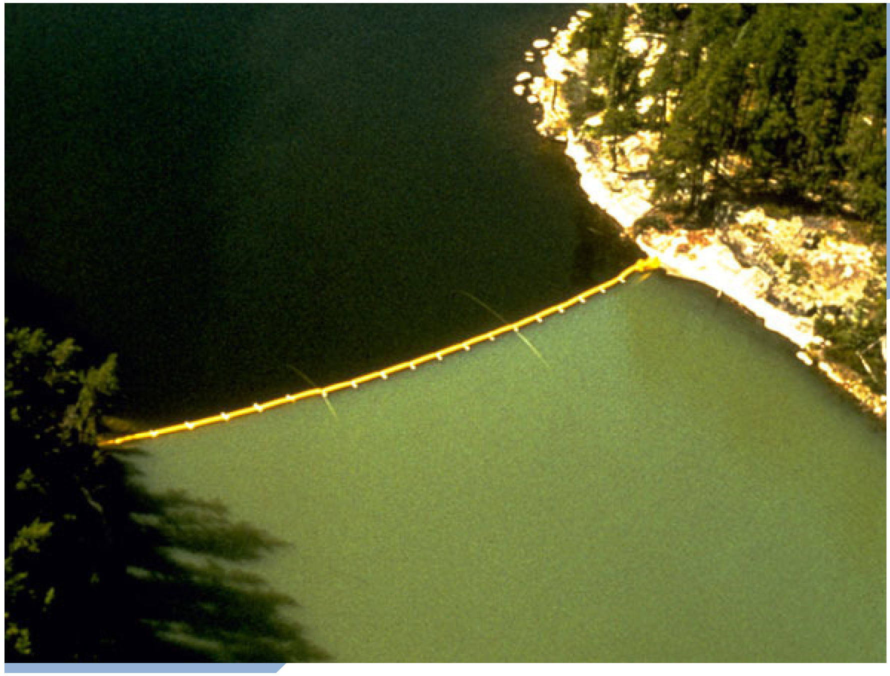
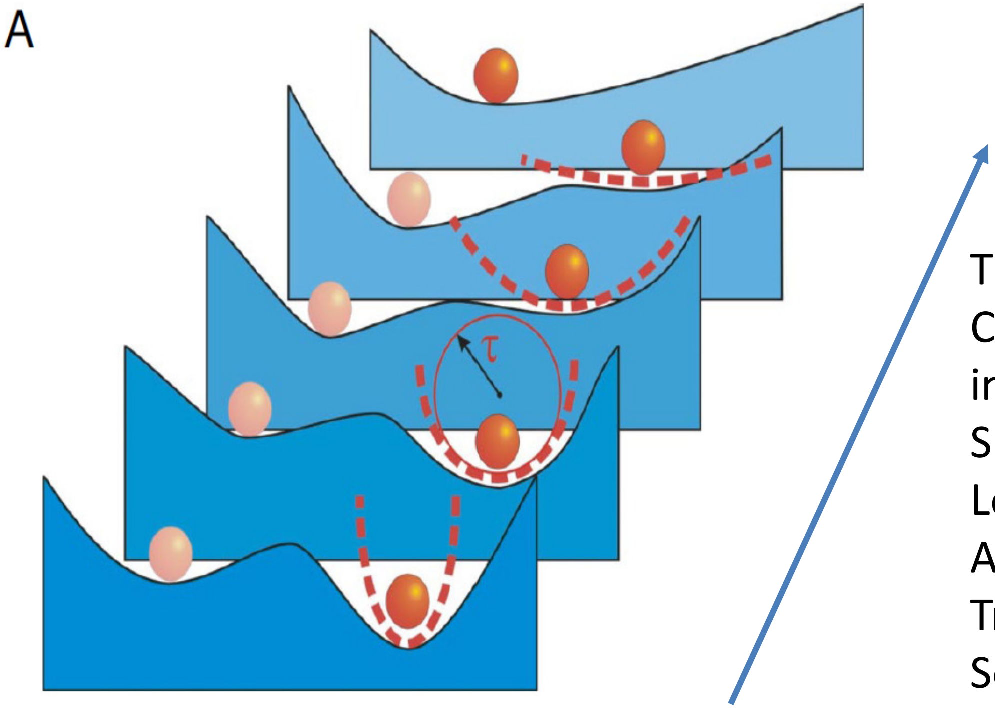
POINT 3: CHANGE (CLIMATE, TRADE, SOILS) CHANGES RESILIENCE

Changing resilience



Incremental changes can have little effect until close to a tipping point, where resilience can degrade rapidly



Time
Changing climate intensification
Slow soil degradation
Loss of biodiversity
Air or water quality
Trade patterns
Social norms

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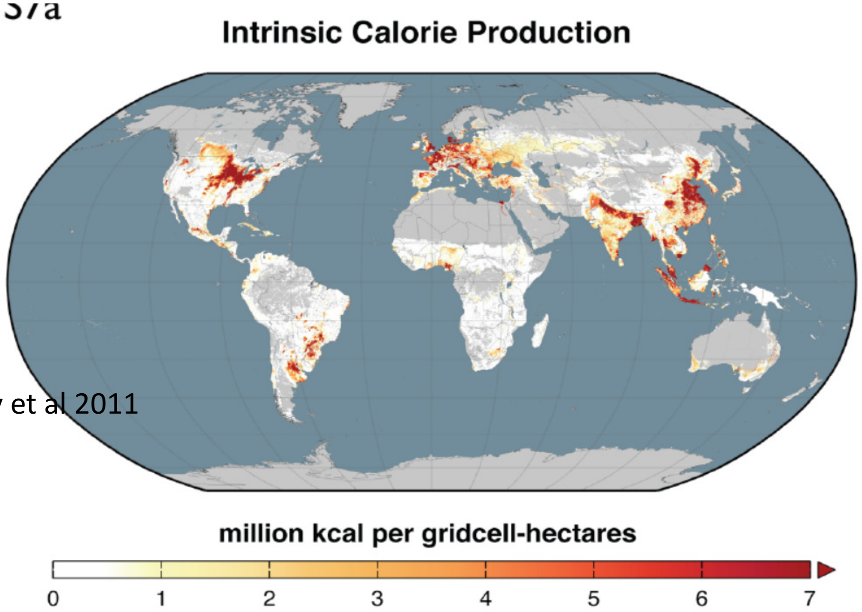
POINT 4: RESILIENCE TO SHOCKS VS RESILIENCE TO CHANGE

Fig 37a



Foley et al 2011

Global markets driving (narrow sense) efficiency lead to concentration in intensive farming, crops, places and risks

Over 50% of the world’s crop calories come from wheat, rice and maize, adding sugar, barley, soy, palm, potato gets to 76%

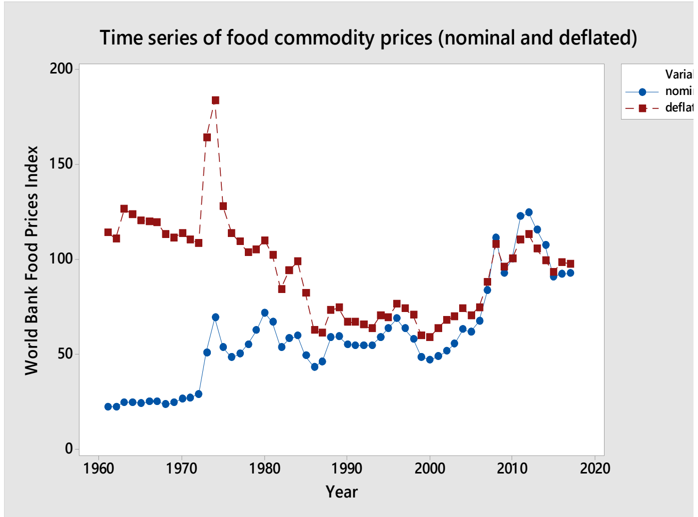
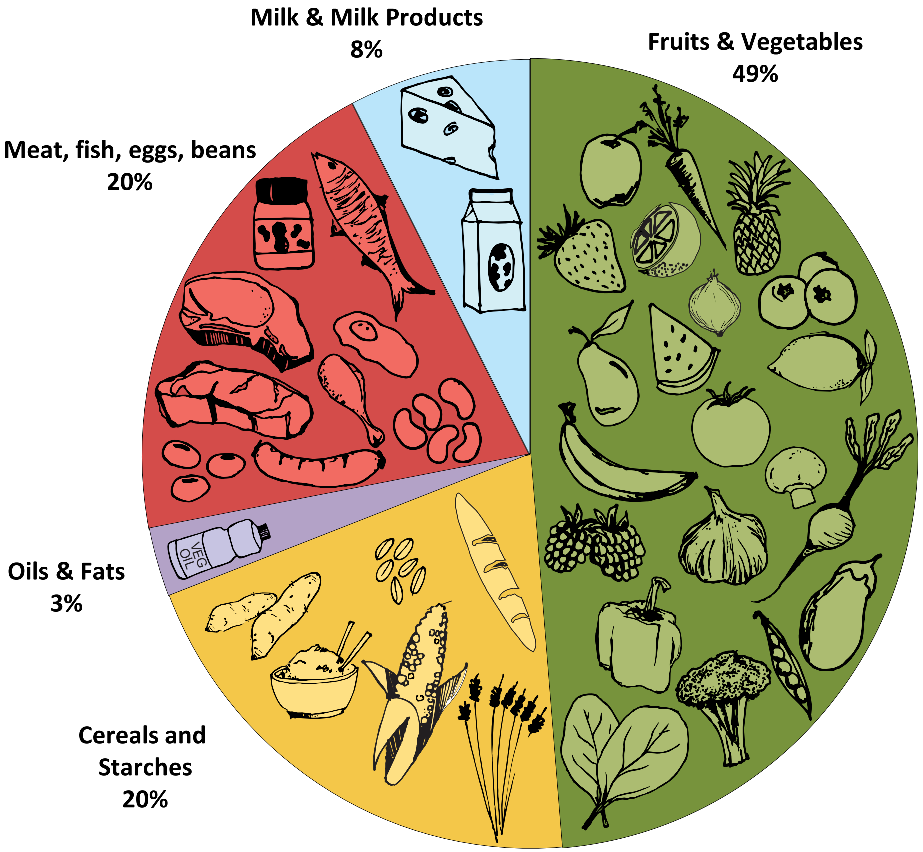
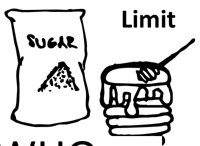


Fig 2.19. Nominal and Real global food prices since 1961
Data from World Bank http://data.worldbank.org/

What we should be eating
(Harvard's Healthy Eating Plate Model)





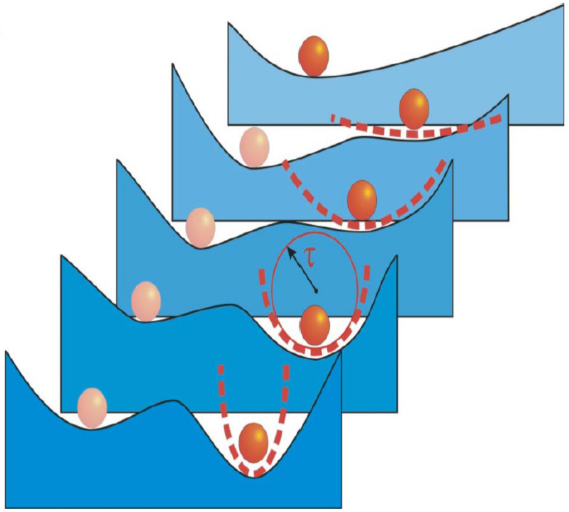
WHO<
5%

The food system is on an unsustainable trajectory

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

A



- GHG emissions are contributing to climate change
- Malnutrition in all its forms is growing
- The food system is highly inefficient
- “narrow-sense” efficiency drives concentration of risk in few crops, few breadbaskets, highly connected systems, at the same time that shocks are increasing

Narrow-sense efficiency model is problematic

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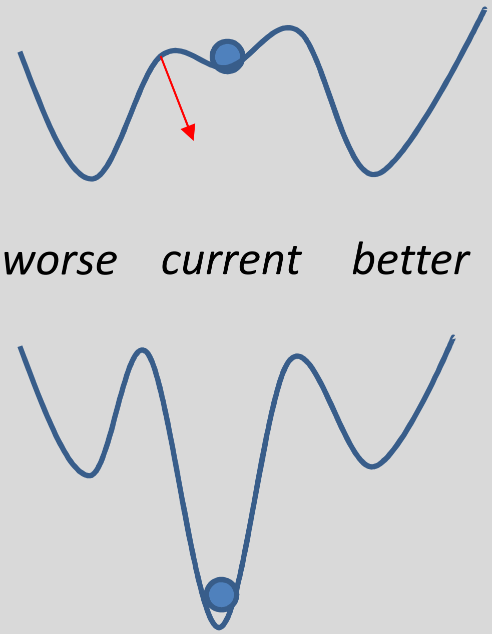
The system as a whole is very resilient to transformation to a "better" state

Food system functioning



Food system governance (WTO, ag policies, market forces and concentration)

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CONCLUSIONS

Routes to resilience

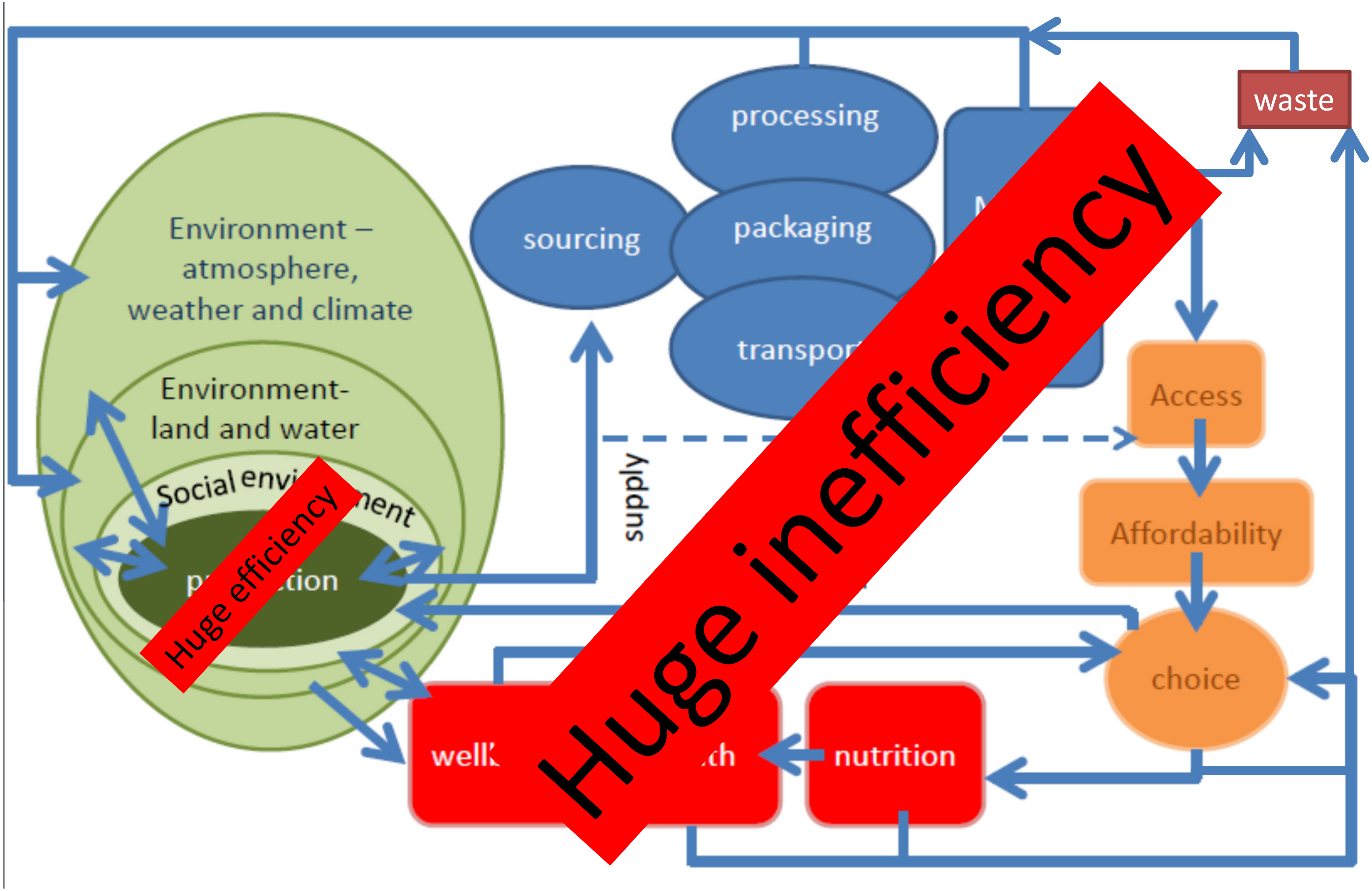
Historically:
- balance of local and traded
- Diversified (not all eggs in one basket)
- Food stores

Farming
- Genetics
- Soils
- Pests and diseases
- Diversity in space and time (rotations) (bet-hedging, plus reduction of homogeneity)
- Forecasts (seasonal, decadal)
- Infrastructure (irrigation)

Food system
- Diversify products and places
- Trade rules (export bans)
- Virtual or real regional food stores
- Transparency of stocks
- Transport infrastructure/chokepoints
- Food culture/waste/market expectations (change demand elasticity)
- Food system efficiency

https://www.foodsecurity.ac.uk/publications/extreme-weather-resilience-global-food-system.pdf

Greater concentration on systemic efficiency will reduce pressure on the whole system



finally

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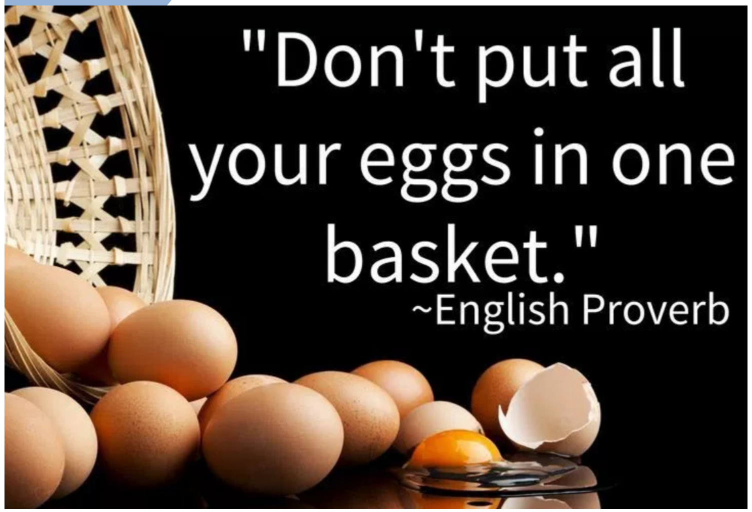

- Systemic resilience may be built around reducing (narrow sense) agricultural efficiency:
  - Efficiency drives scale and concentration on few products
  - Resilience often requires diversification to portfolio

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Thank you!

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