Food futures: the need for innovation

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What is a food system?

Food systems are spatial: the UK imports from 168 countries around the world.
OUR GLOBALISED FOOD SYSTEM IS NOT DELIVERING
Intensification has brought us a long way....

- Global output gone up nearly 4x
- Pop size 3bn to 7bn
Global food system, trade and comparative advantage: extreme concentration

Intrinsic Calorie Production

million kcal per gridcell-hectares

Foley et al 2011
Globalisation, dietary similarity and scale

Increasing homogeneity in global food supplies and the implications for food security

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

- Fruits & Vegetables: 49%
- Meat, fish, eggs, beans: 20%
- Cereals and Starches: 20%
- Milk & Milk Products: 8%
- Oils & Fats: 3%

What we are actually producing
(According to 2011 FAO)

- Fruits & Vegetables: 11%
- Cereals and Starches: 47%
- Meat, fish, eggs, beans: 11%
- Milk and Milk Products: 4%
- Oils & Fats: 11%
- Sugar: 16%

WHO< 5%

Evan Fraser, Guelph, FBS analysis, 2015
Global malnourishment: the food system doesn’t deliver health through diets.
Food loss and waste

Global food losses/waste is estimated to be 1.3 billion tonnes per annum (pa), equating to approximately one third of edible food intended for human consumption.

The total food production of sub-Saharan Africa = EU+N Am food waste (230mt).

Total food waste has enough embedded calories to feed 2-3bn people.

Many reasons for loss and waste: pack size, safety, food is cheap, culture.

Need to recycle “from farm to flush”
GHG emissions by service (50.6 Gt CO2e total)

- **Personal travel**: 30%
- **Commuting**: 9%
- **Thermal comfort**: 15%
- **Lighting**: 5%
- **Freight**: 9%
- **Washing**: 9%
- **Industrial equip.**: 10%
- **Construction**: 3%
- **Communications**: 3%
- **Textiles**: 3%
- **Agri-food**: 1%
- **Waste**: 1%

Source: Baizeli et al. (2013)
Forest loss, Rondonia, Amazonia 1984-2006
Soils underpin agriculture

THE WORLD IS CHANGING

Why business as usual is not an option
Gerland et al 2014 Science  World population stabilization unlikely this century

10.9bn (95%CI: 9.0 - 13.2)
50% more (CI 25-88%)
Growing global income creates demand

Tilman et al., 2011 (PNAS)

2000: 60% middle class "western" vs 20% "eastern"
2050: 12% vs 68%
The impact of a global temperature rise of 4°C (7°F)

Climate Extremes Index

Contiguous U.S. CEI (All Steps Combined)
Annual (January-December) 1910-2015
NEED FOR CHANGE
Globally, “business as usual” is unsustainable...

- Demand projections are increasing faster than yield projections. If demand were to be met it would:
  - require 120% more water; 42% more cropland and loss of 14% more forest
  - emit enough carbon dioxide to create 2 degrees of global warming (alone)
  - Create global public health crisis
  - Lead to loss of ecosystem services
Business as usual is a Jevon’s paradox: more is not enough

Production (unsustainable) → Cheap food

Production (sustainable) → “full cost of food”

Waste
Over consumption
Environmental impact
Increasing demand

Less waste
Healthy consumption
Low environmental impact
Less demand

Sustainable nutrition

2/3*2/3*(1-(1/3*1/5)) = 56/135 = 41% used
Food not lost/wasted/fed to animals or overeaten
SUSTAINABILITY, PUBLIC GOODS AND RESILIENCE
Sustainable land use

Sustainability is complex and there is no simple silver bullet to define it. The best thing to do depends on:

• Context
• Scale
• Trade-offs
• Services constrained by local and planetary boundaries that are not well defined and not reflected in market prices
Smarter landscapes are possible.

It is possible to "design" landscapes better to deliver a range of goods (EFAs; RDP; ES).

Payment/subsidy or social license (?)
What drives a farm business?

- "government"
  - ideology
- Trade-policy (extreme inertia) → International competition
  - Tech efficiency
  - Comparative advantage
  - scale
- "BIG AG, CHEAP FOOD"
- Long supply chains
  - Tech efficiency
  - International markets
  - Cheap food
- AG POLICY
  - "SI", low margins
- KIT/INPUTS
- MANUFACTURING
  - standards
- RETAIL
- "sustainable nutrition"

What will drive a farm business in future?

- Social/envt context
  - climate
  - Civil society
- FARM
  - KIT/INPUTS
  - ENV T
  - CONSUMERS
  - Public health
  - citizens

Trade-policy (extreme inertia) → International competition → Tech efficiency → Comparative advantage → scale → "BIG AG, CHEAP FOOD" → Long supply chains → Tech efficiency → International markets → Cheap food → AG POLICY → "SI", low margins → KIT/INPUTS → MANUFACTURING → standards → RETAIL → "sustainable nutrition"
Sustainability requires matching demand to what can be supplied...

Carrying capacity of U.S. agricultural land: Ten diet scenarios

Elementa: Science of the Anthropocene • 4: 000116 • doi: 10.12952/journal.elementa.000116
elementascience.org
FUTURES OF FOOD

Alternative futures suggest different innovation needs
Switching from producer-led to Consumer-led politics?

• “a post-pesticide world”

• Andrew Burgess, Produce World
Future food

Free trade, global markets

Unsustainable and unhealthy diets

Carbon tax; “polluter pays”; education; climate costs mount: Food becomes more expensive

Food tax; healthy eating incentive schemes; health insurance; public health education

Local or regional markets

sustainable and healthy diets

Future food

Unsustainable and unhealthy diets

Free trade, global markets

Growing corporate power (TTIP); drive for economic growth; stable world and governance; strong international co-op

Protectionism; nationalism
Break-up of rules-based international cooperation
War/terrorism; climate migrants
Lack of resilience in trade due to climate/extreme weather

Local or regional markets
Future food

Free trade, global markets
- Unsustainable and unhealthy diets
  - Unchecked consumption
    - Growing ill-health
    - More climate change
    - Trade interests dominate politics
  - Money talks most
    - Disconnected world with weak economic growth
    - “post war economy”
    - Unsustainable production to meet demands locally
    - “spatial inequality”

Sustainable, high-tech world
- Local or regional markets
  - Local is lovely
    - Sustainable nutrition drives local industry
    - “local food” SMES and artisanal food valued
    - Holistic economies – low waste, high health and well being
    - “spatial inequality”

Sustainable and healthy diets

Future food systems-a-scenarios-analysis
Conclusions: the past and future will be radically different

- The current food system is globally unsustainable
- Decarbonisation of the economy will require land use response, and dietary/demand change is one route
- Dietary change, and waste reduction, would also “free up” land for NETS/BECCS and other bioeconomy products
- Climate change will increasingly challenge the sector, and may drive diversity, sustainability and resilience
- Trade-relationships, and local demand, will determine needs from the sector
Thank you!

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