SCAR
Standing Committee
on Agricultural Research

Sustainable Food Consumption and Production in a Resource-Contrained World

Erik Mathijs, K.U.Leuven

Integrated Pest Management - the way forward to Sustainable Agricultural Production

19 June 2012

Foresight Expert Group 3

- **Annette Freibauer** (chair) (D) - Head of Emission Inventories Group, Institute of Agricultural Climate Research, von Thünen-Institute
- **Erik Mathijs** (rapporteur) (BE) – Katholieke Universiteit Leuven
- **Gianluca Brunori** (IT) - University of Pisa – Department of Agronomy and Management of Agro-Ecosystems
- **Zoya Damianova** (BU) - Programme Director Innovation Programme - Applied Research and Communications Fund
- **Elie Faroult** (F) - International Consultant, Brussels
- **Joan Girona i Gomis** (SP) - Director Irrigation Technology IRTA
- **Lance O'Brien** (IRL) - Head Foresight and Strategy Development, Teagasc
- **Sébastien Treyer** (F) - Directeur des programmes, Institut du développement durable et des relations internationales IDDRI

Background

- Standing Committee on Agricultural Research (SCAR), est. 1974, renewed in 2005
- Formed by MS representatives, presided by EC representative
- Advise EC and MS on the coordination of agricultural research in Europe
- Initiatives:
  - Common research agendas (collaborative working groups, JPI)
  - Mapping capacities
  - Foresight monitoring mechanism

Purpose

- **Purpose**: scanning and monitoring exercise of recent relevant national, regional or international foresight activities and science papers (2009 / 2010)
- **Emphasis**:
  - Resource scarcities and adverse environmental impacts
  - Role of the Knowledge-Based Bio-Economy
  - Balance between food, fibre, feed and fuel + new technologies towards sustainable, green bio-economy
- **Final aim**: building blocks for longer-term perspective to prepare a smooth **transition** towards a world with resource constraints and environmental limits

Main messages

1. Sense of urgency due to resource scarcities **accelerates** (due to interactions)
2. Way we look at problems and solutions **differs fundamentally** between productivity-oriented and sufficiency-oriented thinking
3. Productivity-oriented thinking still **dominates**, but technological solutions alone are inadequate
4. **Concerted** efforts are needed to enable the transition to a truly efficient and resilient agrofood system (policy at all levels, R&D, business)

Main messages

5. Main leverage points:
   - Radically increase resource use efficiency (eliminate waste at all levels)
   - New business models (organizational innovation)
   - Healthy consumer diet, worldwide
6. Not productivity **or** sufficiency, but productivity **and** sufficiency – **all approaches are necessary, no silver bullet**
7. Research: more coordination, more true transdisciplinarity, more room for (system) experimentation

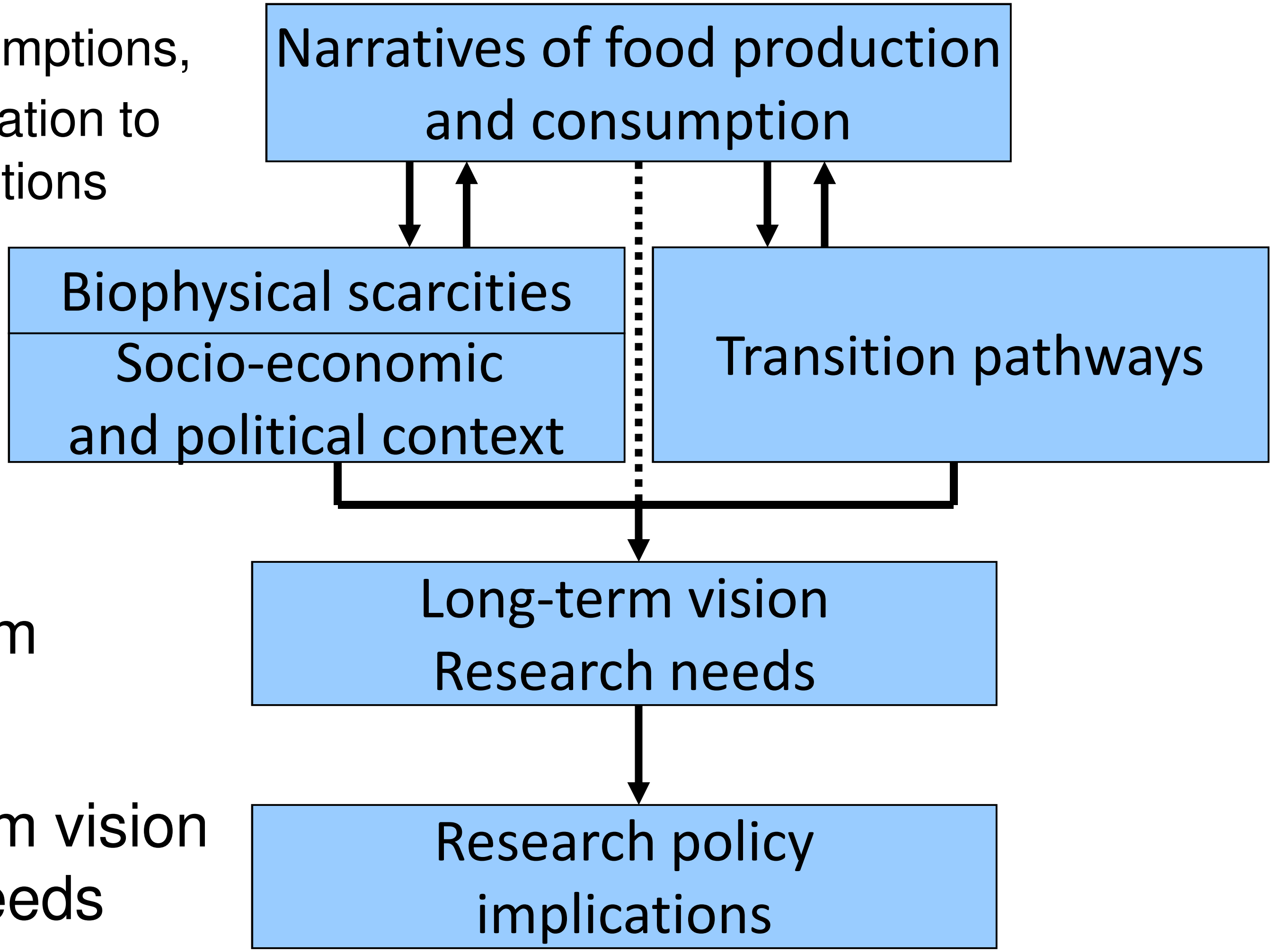
The approach

Starting point:
Extreme ends, assumptions, simplifications in relation to scarcities and transitions

New insights since FEG2

Conclusions from insights

Conclusions from vision and research needs



We show directions for solutions but even more, how research can direct us towards them

Scarcities

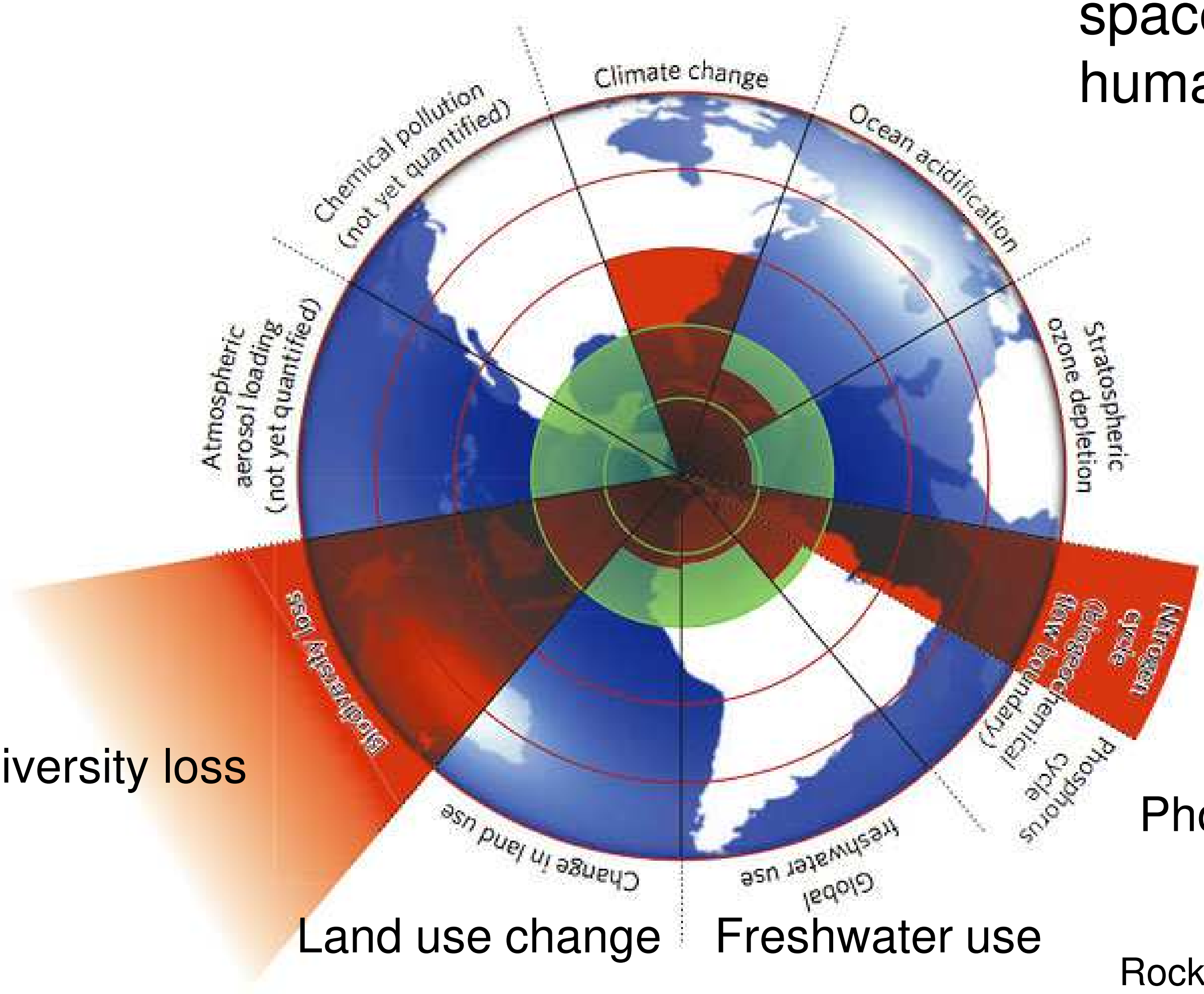
- ***Definition*: a social concept of imbalances, inefficiencies, constraints**
- Observed shortage of natural resources,
- Perceived dependency on natural resources and fear of global depletion
- Political, social, organisational, institutional and economic obstacles also contribute to scarcities.
- “Old scarcities”: fertile land, freshwater, energy, P
- “New scarcities” increase “old” ones: climate change, biodiversity loss
- Socio-economic context: agricultural knowledge systems, governance, economic development, urbanization as drivers, barriers and solutions

Passenier and Lak (2009)

‘New’ scarcities

A safe operating space for humanity

Climate change



Nitrogen

Phosphorus

Biodiversity loss

Land use change

Freshwater use

Rockström et al. 2009

Scarcities

Insights:

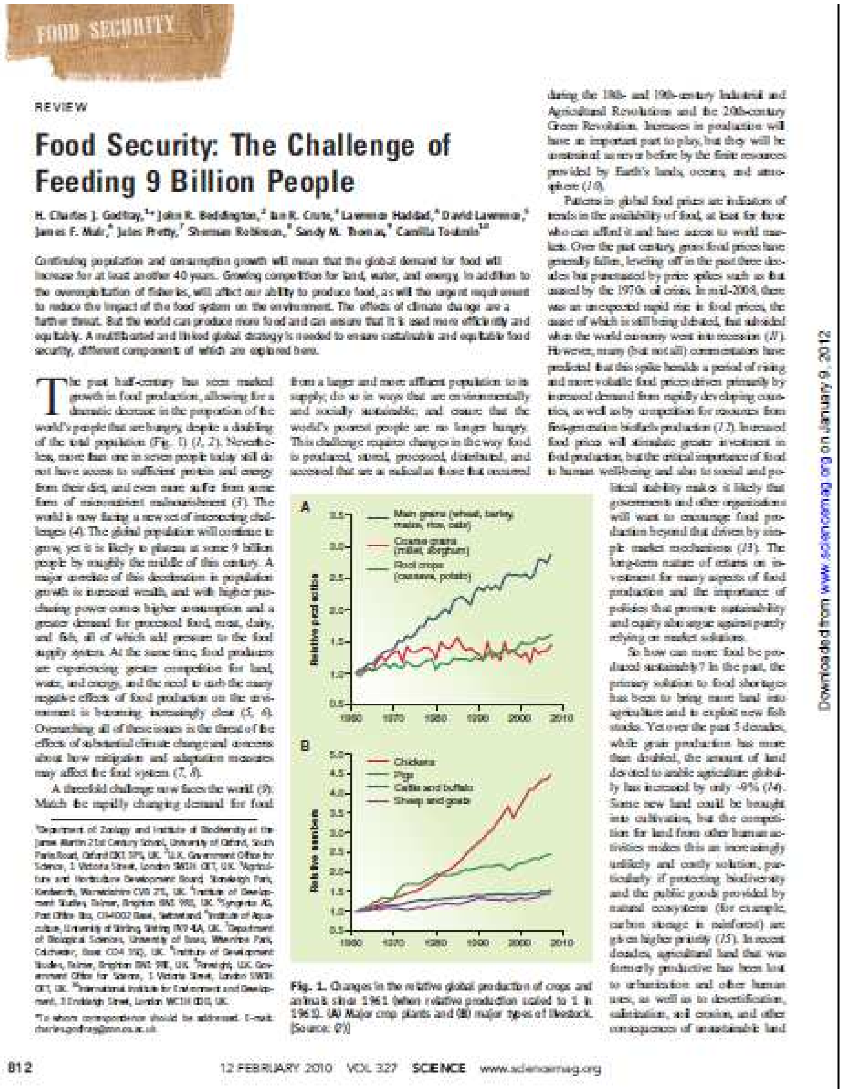
- Economic development = strongest driver, further worsened by urbanisation
- Amount, method and type of food production = strong impact on water, energy and nutrients, pollution and consequences, e.g. climate change and biodiversity loss
- Water, N and energy: no shortage, but efficiency issue
- P least connected to other scarcities
- Climate change and biodiversity loss aggravate each other in manifold ways, but badly understood; combined effect makes food production system vulnerable

Scarcities

- Reinforcing feedbacks that speed up change are the most prominent mechanism of interactions between scarcities.
- Tipping points = unquantifiable risk for food security; mainly related to climate change - biodiversity relations.
  - Die-back of coral reefs, destruction of coastal ecosystems and over-exploitation of marine resources = most urgent, maybe even catastrophic risks for global food security
  - Systemic instability = large-scale, multi-source pressures
- Time lagged scarcities (P, soil degradation, genetic diversity) underresearhed
- Governance = key root of any scarcity + heart of the solution

Godfray et al., Science, 2010

- Closing the yield gap
- Increasing production limits
- Reducing waste
- Changing diets
- Expanding aquaculture



FOOD SECURITY

REVIEW

Food Security: The Challenge of Feeding 9 Billion People

H. Charles J. Godfray, John R. Beddington, Ian R. Crute, Lawrence Haddad, David Lawrence, James F. Muir, Jules Pretty, Sherman Robinson, Sandy M. Thomas, Camilla Toulmin

Continuing population and consumption growth will mean that the global demand for food will increase for at least another 40 years. Growing competition for land, water, and energy, in addition to the overexploitation of fisheries, will affect our ability to produce food, as will the urgent requirement to reduce the impact of the food system on the environment. The effects of climate change are a further threat. But the world can produce more food and can ensure that it is used more efficiently and equitably. A multifaceted and linked global strategy is needed to ensure sustainable and equitable food security, different components of which are explored here.

Fig. 1. Changes in the relative global production of crops and animals since 1961 (when relative production scaled to 1 in 1961). (A) Major crop plants and (B) major types of livestock.

812 12 FEBRUARY 2010 VOL 327 SCIENCE www.sciencemag.org

Foley et al., Nature, 2011

- Stop expanding agriculture
- Close yield gaps
- Increase agricultural resource efficiency
- Increase food delivery by shifting diets and reducing waste

ANALYSIS

Solutions for a cultivated planet

Jonathan A. Foley[1], Navin Ramankutty[2], Kate A. Brauman[1], Emily S. Cassidy[1], James S. Gerber[1], Matt Johnston[1], Nathaniel D. Mueller[1], Christine O'Connell[1], Deepak K. Ray[1], Paul C. West[1], Christian Balzer[3], Elena M. Bennett[4], Stephen R. Carpenter[5], Jason Hill[1,6], Chad Monfreda[7], Stephen Polasky[1,8], Johan Rockström[9], John Sheehan[1], Stefan Siebert[10], David Tilman[1,11] & David P. M. Zaks[12]

Increasing population and consumption are placing unprecedented demands on agriculture and natural resources. Today, approximately a billion people are chronically malnourished while our agricultural systems are concurrently degrading land, water, biodiversity and climate on a global scale. To meet the world's future food security and sustainability needs, food production must grow substantially while, at the same time, agriculture's environmental footprint must shrink dramatically. Here we analyse solutions to this dilemma, showing that tremendous progress could be made by halting agricultural expansion, closing 'yield gaps' on underperforming lands, increasing cropping efficiency, shifting diets and reducing waste. Together, these strategies could double food production while greatly reducing the environmental impacts of agriculture.

Agricultural extent

Crop yields

The state of global agriculture

©2011 Macmillan Publishers Limited. All rights reserved

Two Narratives

- **Narrative**: discourse based on a coherent set of assumptions and principles underpinning and communicating a certain worldview
- Levidow (2008):
  - descriptive accounts: claims about objective reality as threats, opportunities and imperatives
  - normative accounts: claims about necessary or desirable responses to that objective reality
  - policy instruments for carrying out those responses

  “Regardless of its stated aims, a dominant narrative succeeds in the normative sense of gaining resources and power, while pre-empting alternative futures”

The Productivity Narrative

- *The problem* - World population 9.2 billion in 2050 - agricultural productivity slowing down - rising income levels shift diets to more protein rich food and will increase energy demand - serious threat that food demand will not be met - hunger and political instability - resource constraints and climate change limit the world's capacity to expand food production.

- *The solution* - Scientific advances have the potential to bring forward varieties, breeds and technologies that boost productivity and take into account resource scarcities and environmental problems - massive investments into R&D -removal of barriers to adoption by farmers, such as infrastructure, trade barriers and access to markets.

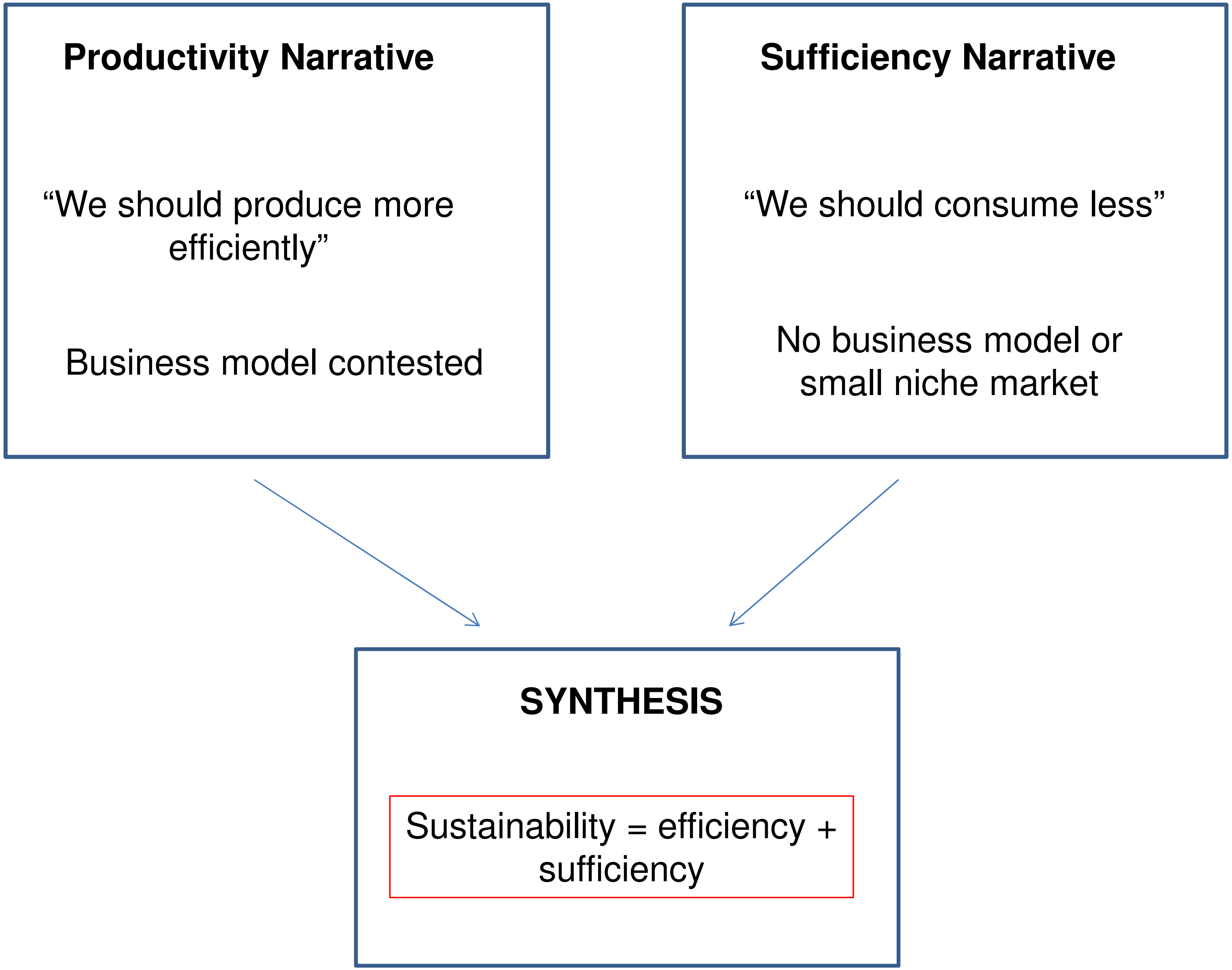
MORE WITH LESS

The Sufficiency Narrative

- *The problem -* World population 9.2 billion people in 2050 - dramatic environmental problems - no Earth capacity to support consumption - current food systems produce waste and overconsumption - mass health problems - destruction of important ecosystems will have dramatic feedback effects that undermine the foundations of our food systems - more poverty and conflict.

- *The solution -* Scientific advances have the potential to bring forward agro-ecosystems that are both productive, respectful for ecosystems and resource saving - demand increases need to be mitigated through behavioural change - environmental externalities need to be internalized in markets -appropriate governance structures that address disruptive effect of trade.

LESS IS MORE


Productivity Narrative
“We should produce more efficiently”
Business model contested
Sufficiency Narrative
“We should consume less”
No business model or small niche market
SYNTHESIS
Sustainability = efficiency + sufficiency

Transitions

- Processes instigated to achieve **long-term** changes in **systems** so that “wicked” problems (such as potential scarcities) can be tackled
- Entail a wide **complexity** of interrelated developments in economics, culture, technology, institutions and the environment
- Imply great **uncertainty** because the course they take is unpredictable and is influenced by exogenous factors

Passenier and Lak (2009), Loorbach and Rotmans (2010)

Transitions

A transition is a ***social transformation process*** with the following characteristics:

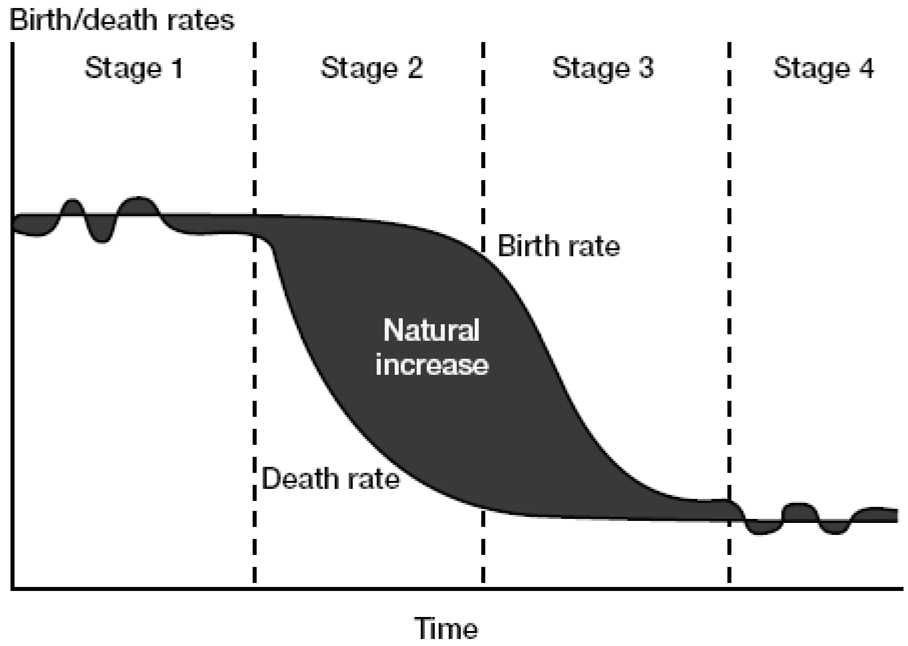
- structural change in society (or complex subsystem of society)
- a long-term process that covers at least one generation
- large-scale technological, economic, ecological, socio-cultural and institutional developments that influence and strengthen each other
- interactions between developments at different scale levels

(Jan Rotmans)

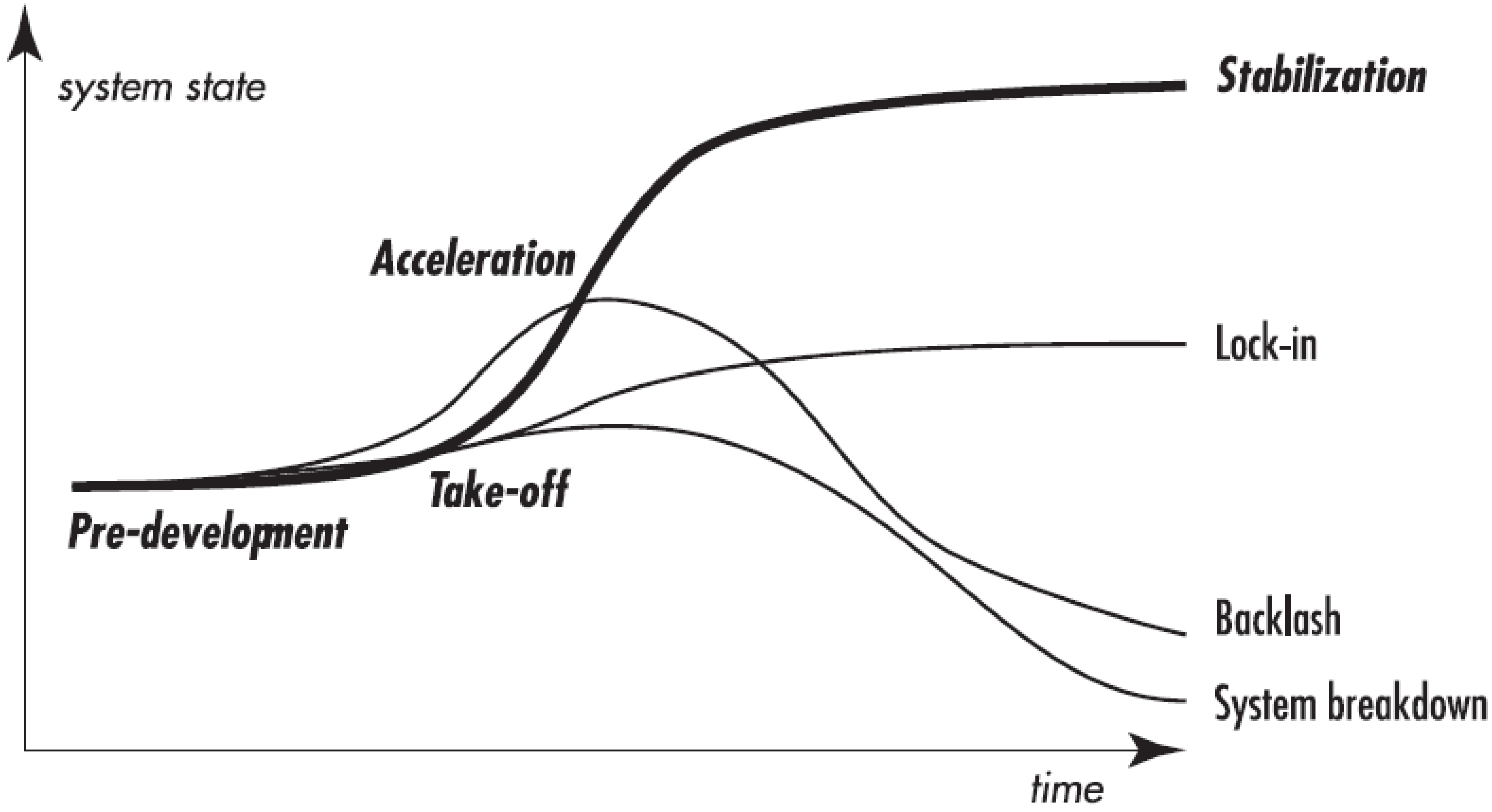
Transitions

- Fundamental system changes towards sustainability
- Long run
- Integrated approach
- Multiple actors from multiple domains
- Multi-level

The Classic Stages of Demographic Transition



Note: Natural increase or decrease is produced from the difference between the number of births and deaths.



The different phases of a transition and different transition pathways (Rotmans, 2005)

Implications

- Traditional approach fails: worked well in the past, insufficient progress towards sustainability, innovation gap, narrow focus not aiming at tackling multiple challenges simultaneously
- New approach of two parallel and overlapping approaches:
  - Build on existing technologies and knowledge systems
  - Develop radically new farming systems

Implications

- Build on existing food systems (component type research):
  - Builds on existing research on productivity and sustainability
  - ‘Incremental approach’ (NRC), ‘Sustainable Intensification’ (The Royal Society)
  - Identify and develop methods that enhance certain aspects of sustainability
  - socio-economic and cultural research needed to accelerate adoption

Implications

- Develop new food systems (holistic):
  - Builds on science & technology in which agriculture is a vital component in the management of natural resources and emphasizes a systems-based approach to knowledge production and sharing
  - Current knowledge infrastructure excluded ecological, local and traditional knowledge, but also the socio-cultural sciences → embrace broader set of understandings + focus on multiple scales
  - Builds on the strengths of natural systems and favors diversity that is fundamental to design resilient systems