The Horizon for Technologies in Future Proofing Food Systems
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To cite this version:
Hugo de Vries. The Horizon for Technologies in Future Proofing Food Systems. Italian Society of Food Science and Technology Conference, Jun 2019, Bologna, Italy. pp.1-25. hal-02934216

HAL Id: hal-02934216
https://hal.inrae.fr/hal-02934216
Submitted on 9 Sep 2020

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The Horizon for Technologies in Future Proofing Food Systems

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Content

- What are Future Proofing Food Systems?
- Where are we?
- What do we need?
- And for food science and technology > radical innovations?
- Examples of potential solutions?
- A need for a food systems approach?
What are Future Proofing Food Systems?

• HLPE (2017): “a food system that ensures food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition of future generations are not compromised”.

• The definition lacks references to:
  – circular (bio-)economy,
  – cultural aspects and
  – optimal usage of natural and input from human resources;

• The questions evokes key issues as inclusiveness, consumption behaviour, affordability in economic terms, policy measures, nutrition in either ‘sufficient calories’ or ‘balance diets’ and ICT and digitalisation.
Where are we?

- An enormous challenge
And yet in some alarming zones

https://www.stockholmresilience.org/research/planetary-boundaries.html
And other major challenges?

**Exponential curves**

We are currently **extending the expiry date** of our planet.

We are not heading towards a sustainable, circular bio-economy (spiral)

We are not able to take away the uncertainties about a well-balanced society

http://www.worldometers.info/
What do we need?

A viable planet!, in terms of:

• Healthy inhabitants
• A viable habitat / environment
• A pleasant & respectful socio-economic context
• An aesthetic image

Sinusoidal curves
A frame where we balance at the edge of order and chaos

Interactions between persons, constituents (in e.g. biomatter) /factors/..

- Chaos (supercritical, unstable)
- Order / Rigidity (sub-critical, stable)

Number of different constituents / factors / persons/..

Ref: Kauffman, Prigogine, Holland
What does it mean for food?

> we need to redefine the limits

Vitality / ‘richness’

Non-vital planet earth: chaos

Scenario 1

Non-vital planet earth: rigid, dead

Scenario 2

Luxurious products/services

Primary needs

- Green-house effect
- Bio- &Food- diversity loss
- Population growth
- Poverty
- Food insecurity
- Insufficient arable land
- No drinking water
- Hazards (microbial, chemical)

Time

2015

2050

Net effect?
Radical innovations needed in Food / ruptures (I)

1. **Avoiding unnecessary exploitation of resources:**

- from products towards services & **de-materialization**, 
- low density – high *satiety* food, 
- alternative protein sources 
- utilization the richness of nature’s structures (biomimetics), 
- **waterless** systems, 
- **synthetic biology** pathways, 
- energy **only from the sun** (avoid the use of biomass), 
- new breeding strategies for **entire** plant usage, 
- ..
Radical innovations needed in Food technology / ruptures (II)

2. Efficiently transforming and using agro-resources:

- autocatalytic systems,
- targeted processes (not over-dimensioned)
- process intensification,
- local bio-refineries at the farm (no transport of water & air),
- new ICT driven processes (virtual design, domotics, 3D printing, ...),
- eco-efficient dynamic storage (products in coma),
- high precision water-droplet systems,
- energy efficient desalting of sea water,
- novel biomaterials & packaging concepts, etc.
Radical innovations needed in Food systems / ruptures (III)

3. Valorizing new co-products and waste streams and re-valorize all biomass:

- eco-pyramid valorization,
- aquaponics systems,
- new salt tolerant species,
- diverse agro-ecological-based products
- industrial ecology business concepts,
- circular economy concepts

Food Science becomes more and more transdisciplinary (management, economics, genetics,...)

Sources: Poyry and Sanders
Ex. waterless system: dry fractionation

WHY RUPTURE? .... Integral use of biomass, no *water added* during processing (thus no drying), local applicability, avoiding water transport, local employment

*Abecassis, de Vries, Rouau, 2013,*...
Ex. entire plant usage; Grap’Sud

→ GrapSud, a union of 7 wine cooperatives located in the South of France, with 210 employees on 6 production sites

Waste valorised:
125,000 tonnes of grape marc
270,000 hl of wine leas
600,000 hl of wine most

→ A diversity of new value-added products issued from by-products

→ New biorefinery and processing schemes.

M. Donner, Naxos conference, 2017
Also, EU NOAW project
Ex. alternative proteins sources & products

meat alternatives on basis of new plant, algae and insect protein sources

WHY RUPTURE? .... Substantial reduction of environmental pressure due to protein-conversion factors and greenhouse gas emissions (CH4, etc.), challenges with nutritional profiles, ...

Inra, WUR, ..
Example: BBI Green Protein Project;
Ex. process intensification: HPHT

Why rupture? Adiabatic heating >> time for processing enormously reduced & No re-packing > treatment in the package itself

**EU IP FP6 NovelQ:** To develop and successfully demonstrate - eco-friendly - novel processing technologies (HPP, PEF, Plasma, microwave, radio frequency, ohmic heating and new packaging materials) for improved quality food and new products (fresh-like character, extended shelf-life)
Ex. targeted processing > EME

- PEF: highly efficient
- Plasma >> most targeted technology (at the edge of thermodynamics and electromagnetism)

WHY RUPTURE? .... Energy for cooking 80% reduced & inactivation of spores at room temperature ...

Ex. Eco-efficient dynamic storage

WHY RUPTURE? .... Energy for climatisation during transport 70% reduced & stand alone & reduction of product loss

Partners: EET, Carrier Transicold, P&O Nedlloyd, The Greenery, Shell Solar, Ecofys, ERBS, WUR
Ex. biodegradable packaging materials

WHY RUPTURE? .... Valorization of largely unused co-products (approx 50% of all biomass) and waste (plus replacing synthetic materials, potential benefits due to biodegradability, ...)

EC-FP7 project, Gontard et al
Ex. Industrial ecology concept

WHY RUPTURE? .... Closed circles/spirals locally > zero waste (potentially), new cooperation forms
Ex. circular economy concept: MELISSA project

Micro-ecological life support alternative *in space*

Higher Plants (IV)

CREW

Photosynthetic (IV)

Liquefying (I)

Nitrifying (III)

Photoheterotrophic (II)

Fun gi

INRA

CO$_2$

CO$_2$

CO$_2$

O$_2$

O$_2$

NO$_3^-$

biodiversity

Low mol. Weight organic fatty acids

waste

biomass

biomass
World food systems would benefit from an *Intelligently Navigated Complex Adaptive Systems (INCAS)* approach.

*Summary IFSET Special Issue 5, France, 2018*
We need inspiration & creativity

Thanks to MC Escher

Diversity interconnected

Thinking in spirals, not in circles

Changing the landscapes & melting zones

Creating ruptures
We need different views; we need you!
Many thanks for your attention

Bioeconomy conference, Paris, 29 – 30 October 2019
EFFoST Conference on sustainability & food, Rotterdam, The Netherlands, 12 – 14 November 2019

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