Towards healthy and sustainable Diets - Challenges in Food production

Wouter-Jan Schouten, Wageningen, January 8, 2020

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TiFN Sustainable Food Systems Program

TiFN is an independent organizer and integrator of multi-disciplinary Innovation and Research programs in the Agro and Food sector

Current PPS projects on sustainable Food Systems with TiFN involvement:

- 2016-20: SHARP
- 2017-21: Sustainable ingredients
- 2018-22: Regenerative Farming
- 2020-27: Technology 4 Ecology (Synergia)

Partners in these projects:

- Knowledge: Wageningen University and research, Utrecht University, TU Delft, TU Eindhoven, TU Twente, University of Amsterdam, Radboud University, 'het Groene Brein'
- Private sector: FrieslandCampina, Unilever, Cosun, Rabo, DSM, Danone, Pepsico, Bel, BO Akkerbouw, NZO, IMEC, Lely, Signify, NXP, Wij.land

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The leading paradigm in agriculture since world war II: maximize efficiency

'Mono' populations in optimized environments

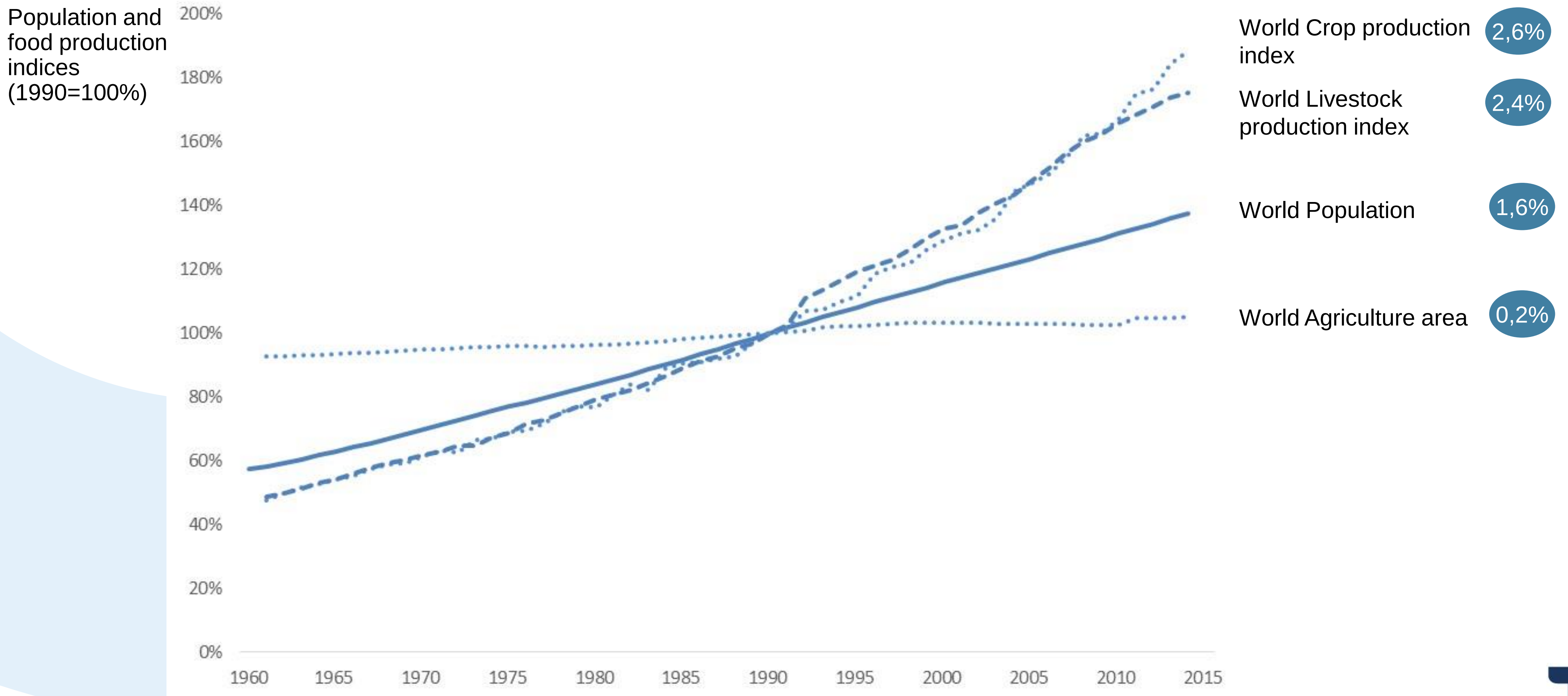
Cheap and predictable food

Simple 'ruling' technology - high inputs – high losses per ha (though low per kg)

Source: Synergia consortium, Peter Groot Koerkamp

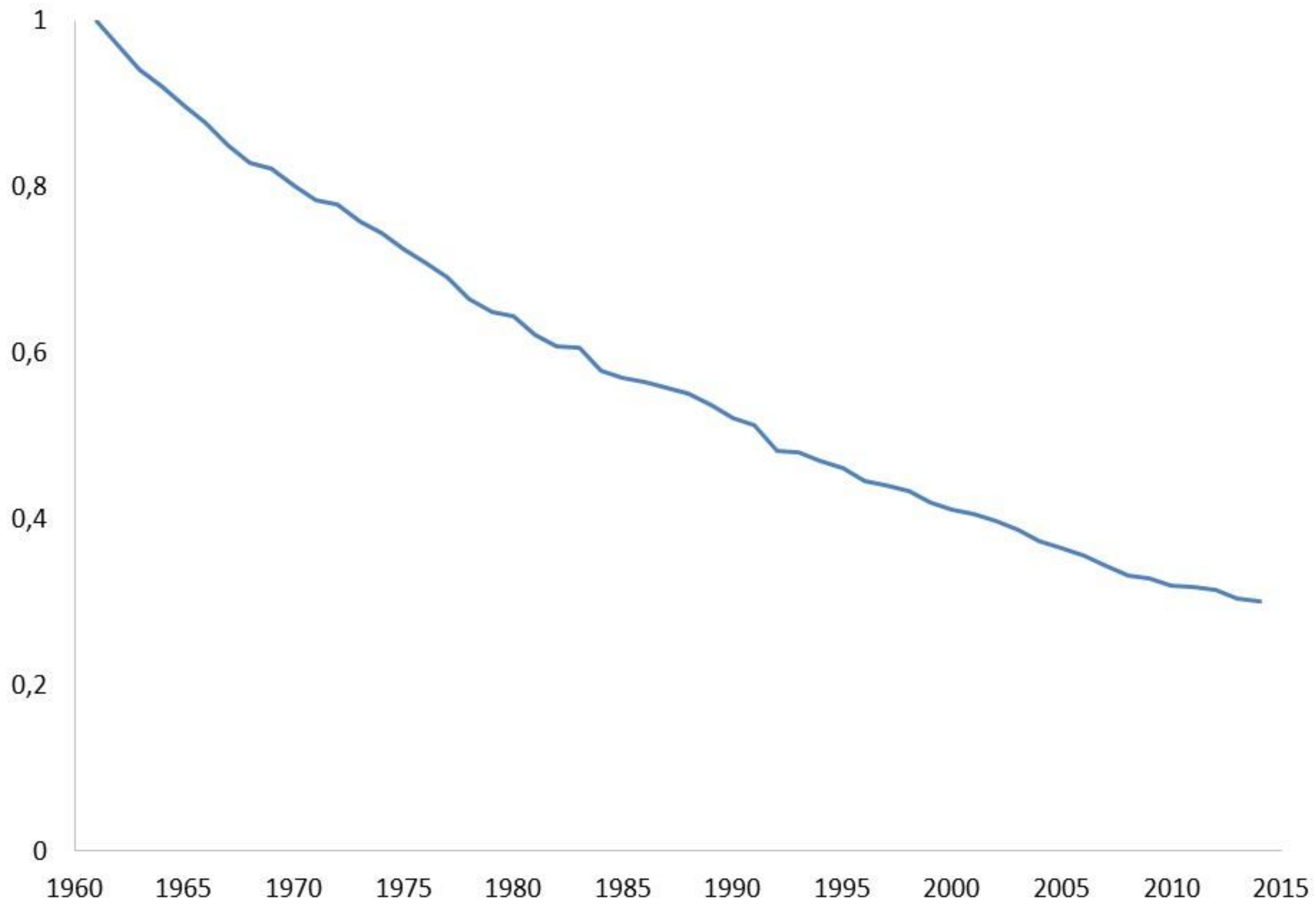
Maximize efficiency has been a very successful paradigm:
Global agriculture production has outgrown world population for over 60 years……..

At a global level, more calories are produced then needed since app. 1990



Source: World development indicators: http://databank.worldbank.org/data/source/world-development-indicators#, FAO: https://ourworldindata.org/hunger-and-undernourishment, Time 2017: http://time.com/4813075/obesity-overweight-weight-loss/

…… and land use footprint per kg has been reduced dramatically….



Source: World development indicators: http://databank.worldbank.org/data/source/world-development-indicators#

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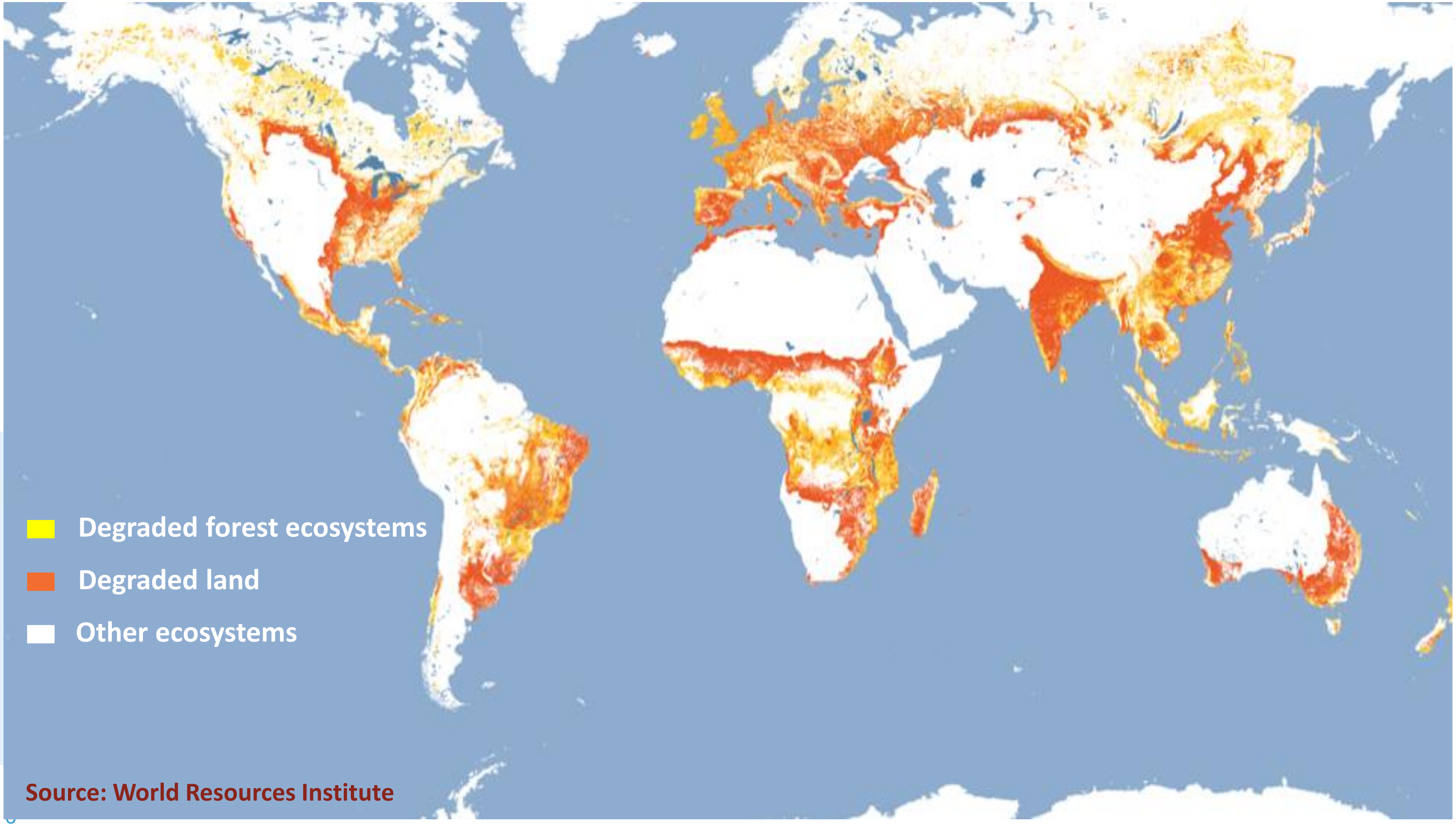
…but land and ecosystem degradation is a global challenge…



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…. and (soil) biodiversity is threatened globally

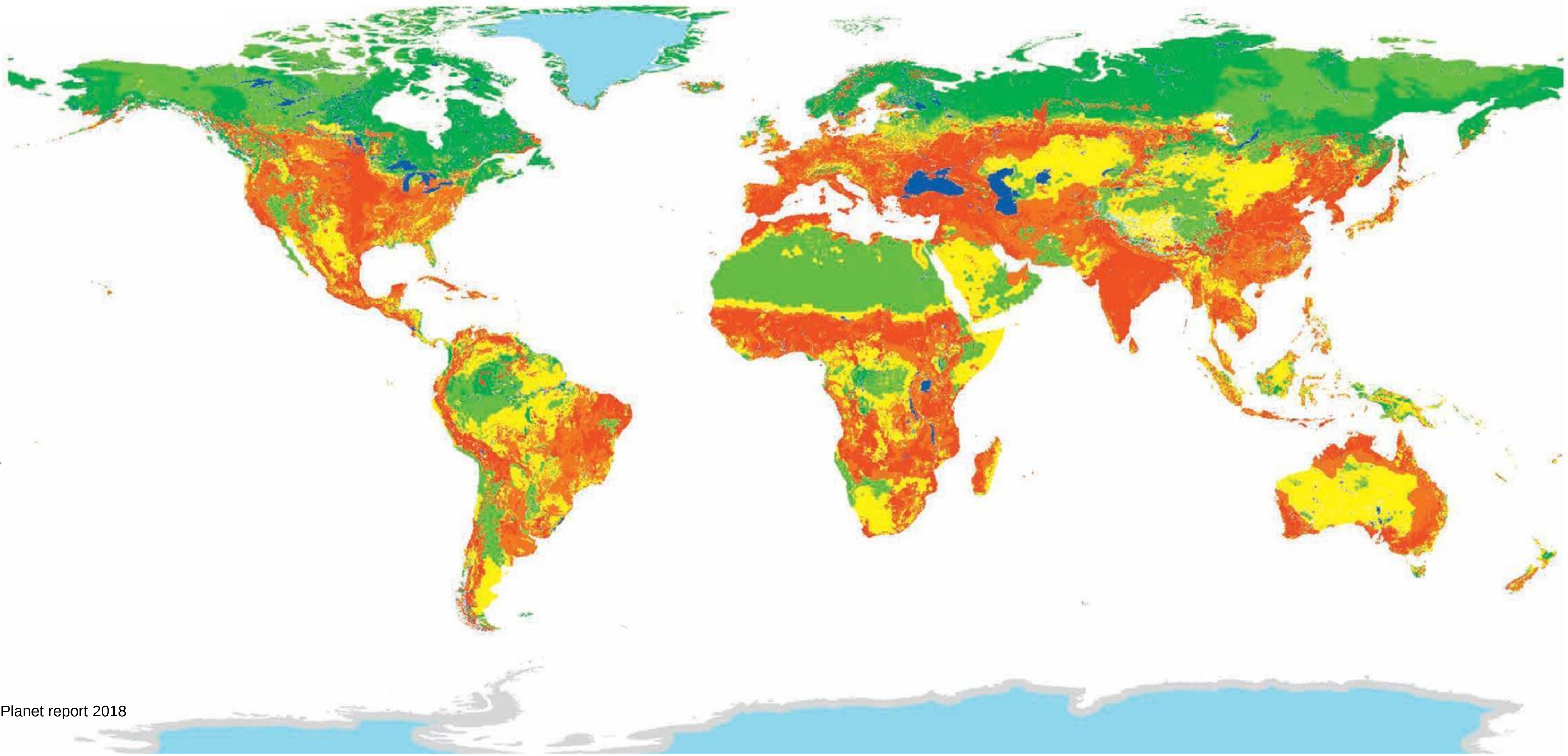

Figure 9: Global map showing the distribution of potential threats to soil biodiversity
All datasets were harmonized on a 0-1 scale and summed, with total scores categorized into five risk classes (from very low to very high)[39].

Key

- Very low
- Low
- Moderate
- High
- Very high
- Not available
- Water
- Ice

Source: WWF Living Planet report 2018

Need to bend the curves on six earth system processes (EAT-Lancet, 2019)

but how?

Earth system process	Control variable	Boundary (Uncertainty range)
Climate change	GHG emissions	5 Gt CO_2-eq yr^{-1} (4.7 – 5.4 Gt CO2-eq yr^{-1})
Land-system change	Cropland use	13 M km^2 (11–15 M km^2)
Freshwater use	Water use	2,500 km^3 yr^{-1} (1000–4000 km^3 yr^{-1})
Nitrogen cycling	N application	90 Tg N yr^{-1} (65–90 Tg N yr^{-1}) * (90–130 Tg N yr^{-1})**
Phosphorus cycling	P application	8 Tg P yr^{-1} (6–12 Tg P yr^{-1}) * (8–16 Tg P yr^{-1})**
Biodiversity loss	Extinction rate	10 E/MSY (1–80 E/MSY)

*Lower boundary range if improved production practices and redistribution are not adopted.
**Upper boundary range if improved production practices and redistribution are adopted and 50% of applied phosphorus is recycled.

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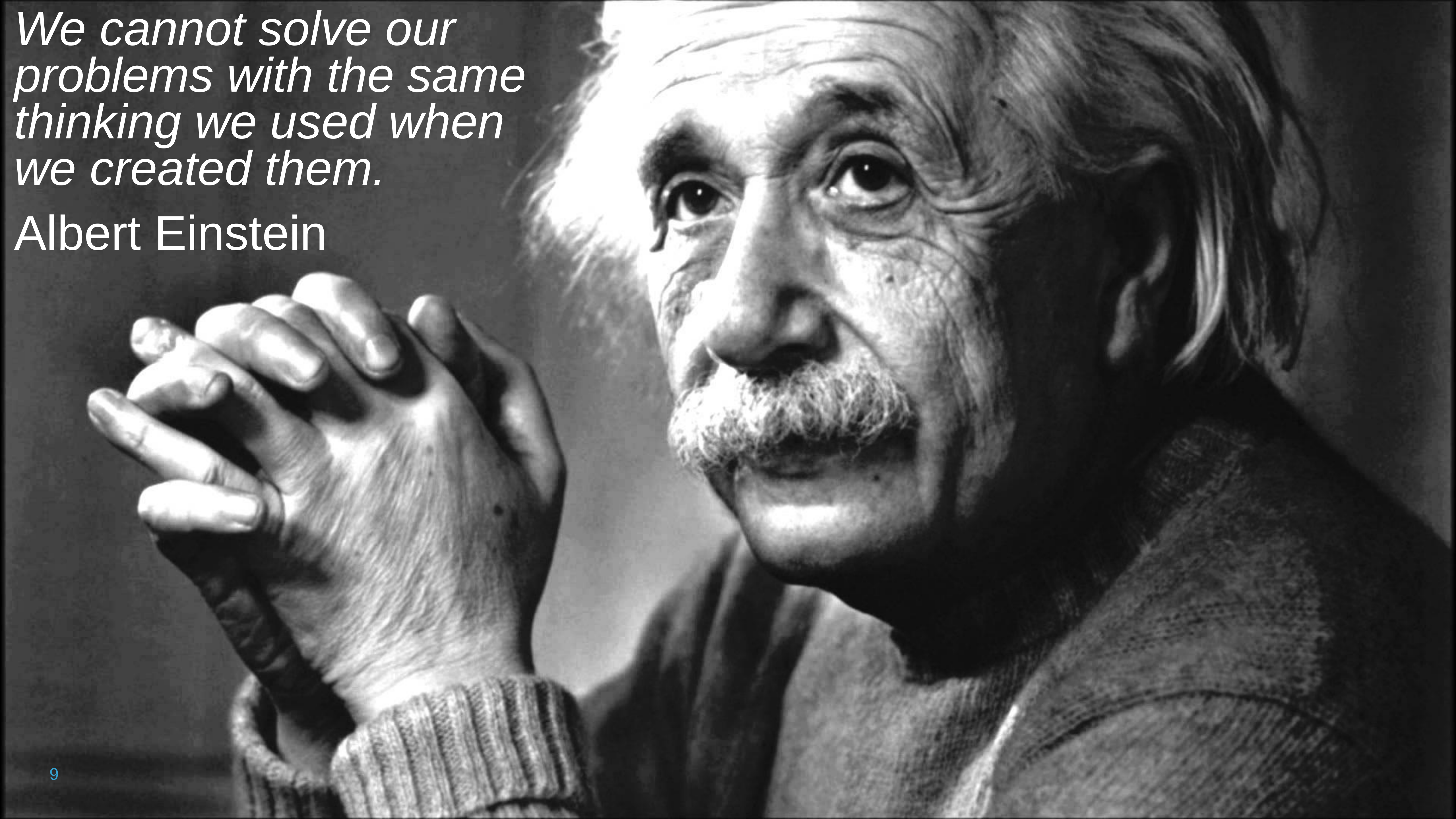
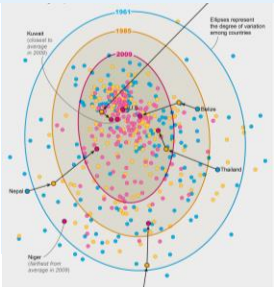

We cannot solve our problems with the same thinking we used when we created them.
Albert Einstein

Need for a new paradigm: Regenerative, circular, ecology-based agriculture

Diverse production with complex interactions



Changing market dynamics and preferences

Intelligent small scale ‘supporting’ technology


 Source: Synergia consortium, Peter Groot Koerkamp

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Need new approaches to get to a regenerative and circular system at scale

	Today's dominant logic	Required for systemic change
Ambition	Volume growth, maximum efficiency; Less Negative impacts	Value growth, optimum efficiency; Net Positive impact
Scope	Supply chains, company by company, commodity by commodity	Integrated Systems: Landscape, value chains, consumers
Breadth of solutions	Dogmatic: prescribe 'one size fits all' agricultural practices	Drive to target outcomes with diversity of agricultural practices

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Proposed objectives of a regenerative agriculture system at scale

Ambition

Need to bend the curves:

- Climate: Carbon capture > GHG emissions
- Land system change: Improve soil quality, enable nature restoration
- Freshwater use: Improve water quality
- Phosporous and Nitrogen: Close nutrient cycles
- Increase biodiversity

A regenerative farming system enables production of *sufficient* food and biomass and enables ecosystems to maintain a healthy state and evolve, while contributing to human well-being and economic prosperity.

Three overarching requirements for the bio-physical system:

- Stocks: all natural capital stocks above threshold levels for resilient agro-ecosystems
- Flows: all ecosystem functions in agriculture areas enabled perpetually
- Neutral or positive impact on natural ecosystems outside agriculture areas

Source: Regenerative Agriculture consortium

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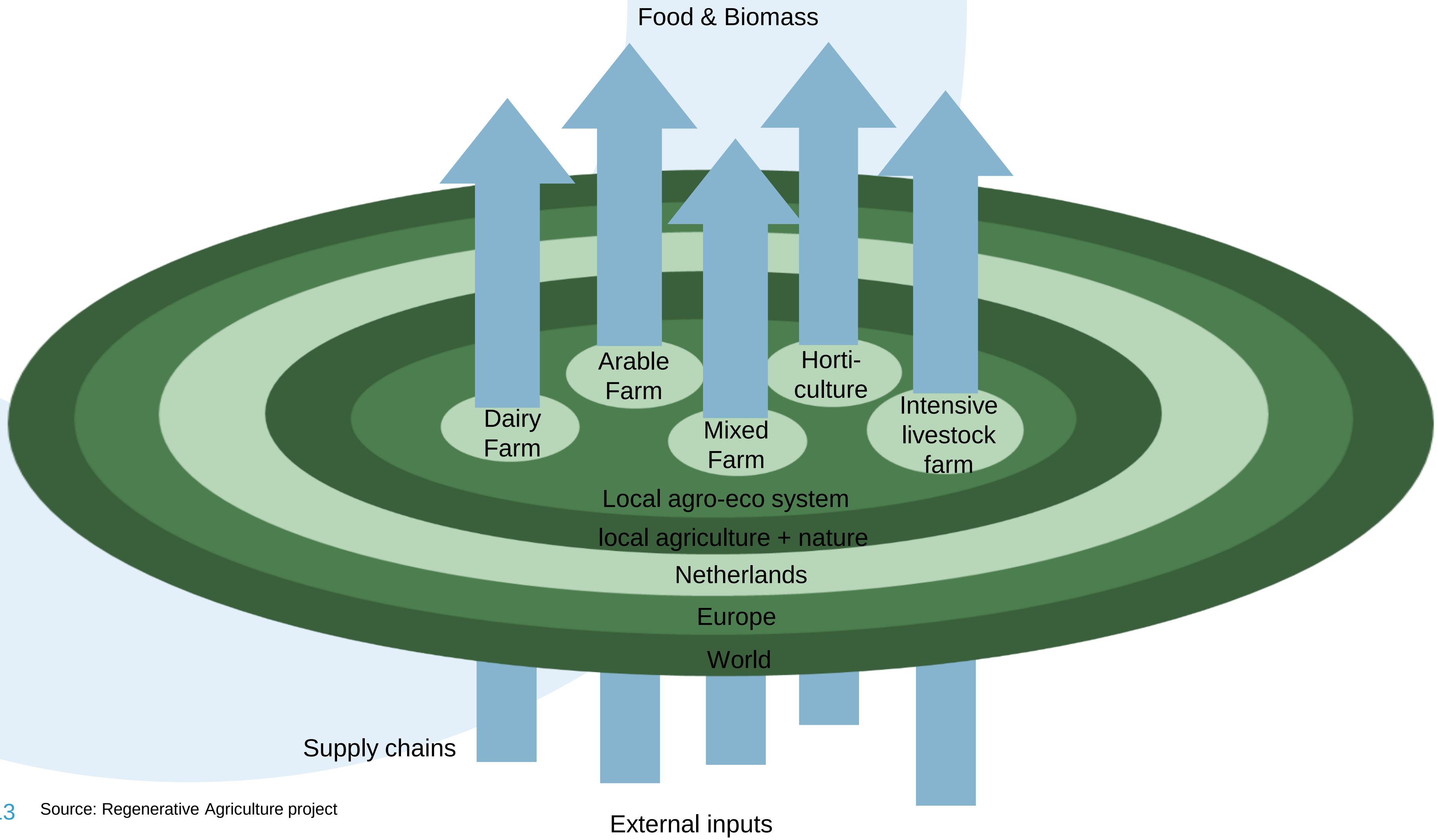
Need integrated system approaches; combining spatial and supply chain dimensions

Scope

And define required outcomes at different system levels



Source: Regenerative Agriculture project

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Need diversity of solutions…….
some examples

Breadth of solutions

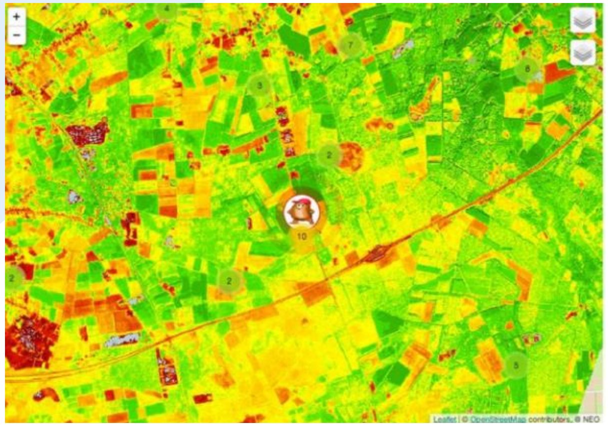
Intercropping

Circular, mixed farm

Agroforestry

Managed/strip grazing

Precision farming



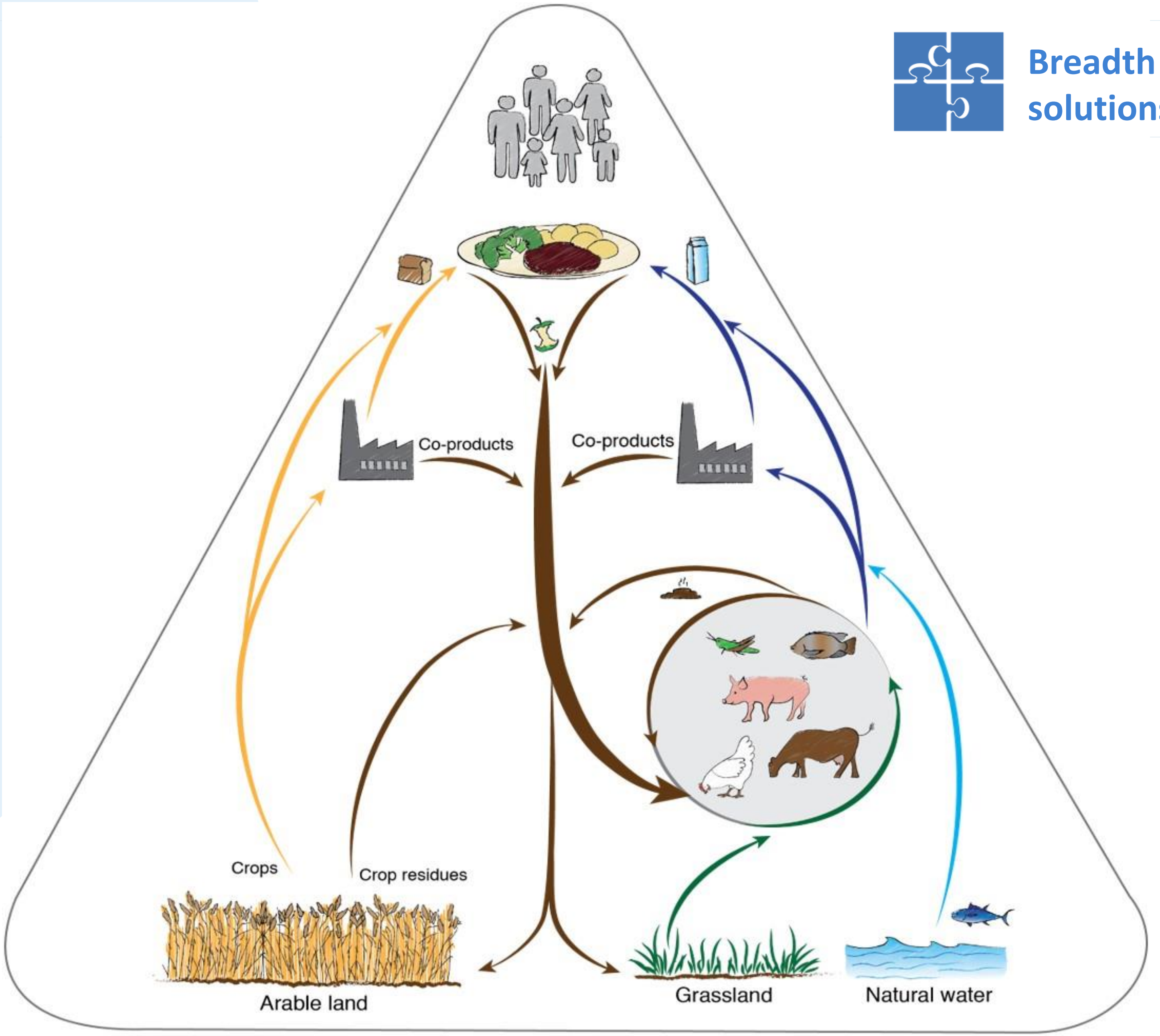
Silvo pastures

Source: Inaugural address Rogier Schulte (2019)/ WUR-FSE Lighthouse farm network, Regenerative agriculture project

…. in a circular system

Breadth of solutions

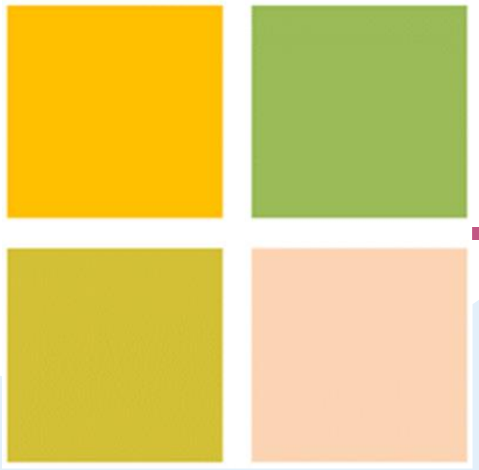
- Upcycling grass resources and food left-overs through farm animals
- Closed nutriënt cycles
- Optimized land use
- Climate neutral nature + agriculture



Van Zanten et al., 2019

Direction in arable farming: Monoculture → intercropping → pixel farming

Today’s dominant model:
Mono-culture

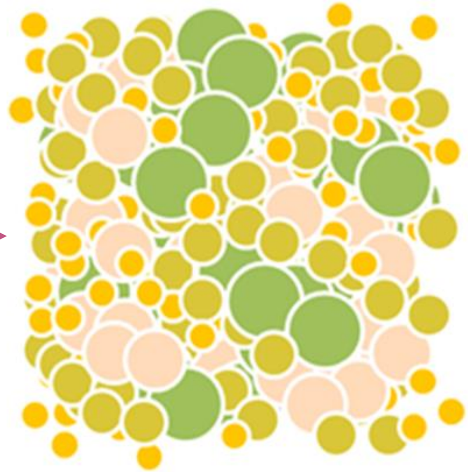


Technology
controls ecology

Today’s state of the art:
Strip intercropping

Technology
enables ecology

Future:
Pixel farming



Technology
collaborates with
ecology

 Source: van Henten & van Apeldoorn, 2018

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Strip/row Intercropping at ERF
(source: inaugural address Rogier Schulte, 2019)

Pioneering ‘lighthouse farmers’ show that business models can be transformed

Always a multi-year transformation process at farm level

Today’s dominant business model

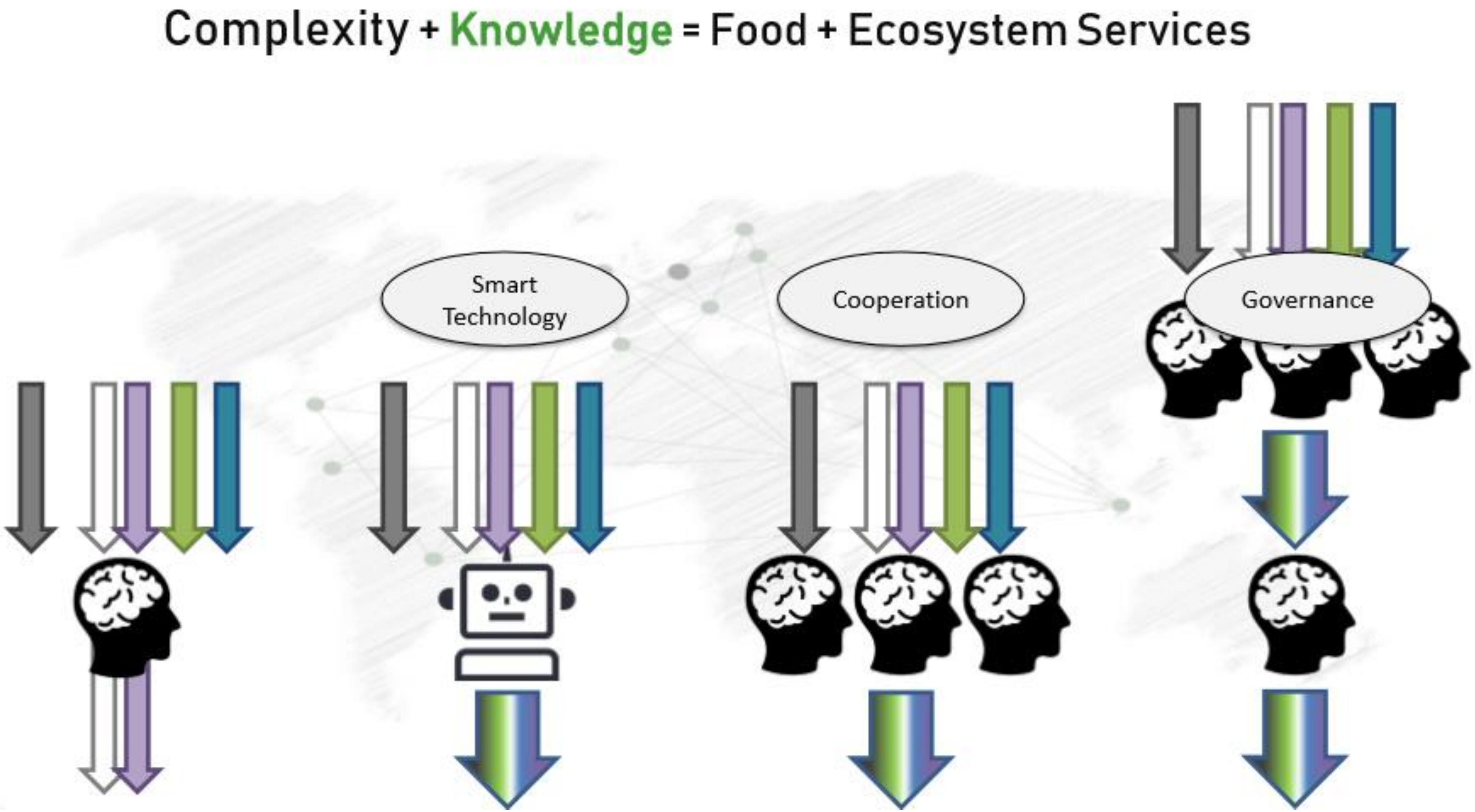
- Commodity product → price is set on world market
- High and ever increasing input costs
- Asset intensive, ‘specialized technology rules’

→ Maximizing volume yields of ‘mono’ populations is the only way to earn a living income

Lighthouse farmers have developed one or more of these competitive advantages:

- Differentiated products → Price premium
- Much lower input costs
- Less asset intensive, ‘technology supports’
- Multi-product synergies (yields and/or costs)
- Revenues from ecosystem services
- Forward integration in short, local, value chains

Levers for system change: smart technology, cooperation and governance (source: inaugural address Rogier Schulte, 2019)



Recap

- Maximize efficiency has been a very successful paradigm. However, the challenge in primary production is no longer to maximize production per hectare but to bend the curves on planetary boundaries
  - Optimize Soil quality, Climate and carbon regulation, Nutrient cycling, Water purification and regulation, Biodiversity and Primary production
- This requires a paradigm shift in agriculture
  - Biophysical logic: from maximize efficiency in supply chains to regenerative foodscapes
  - Economic logic: from commodity production and volume growth to differentiation and value growth
- Need diversity of solutions, many of which exist today (at small scale)
  - High diversity of practices but all are embracing ecological complexity
- Transformation at scale requires transformation at many individual farms, from asset intensive to knowledge/experience intensive
  - Supported by farmer cooperatives,
  - supported by smart technologies,
  - and supported by effective 'governance for diversity' by value chain partners, governments and finance

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