TempAg
SCIENCE FEEDING TEMPERATE AGRICULTURE

INRA
SCIENCE & IMPACT

Foresight workshop
London, October 7, 2016

Future priorities for TempAg

nutrient cycling

Delivering assessments for policy, industry and society needs

Jean-François Soussana

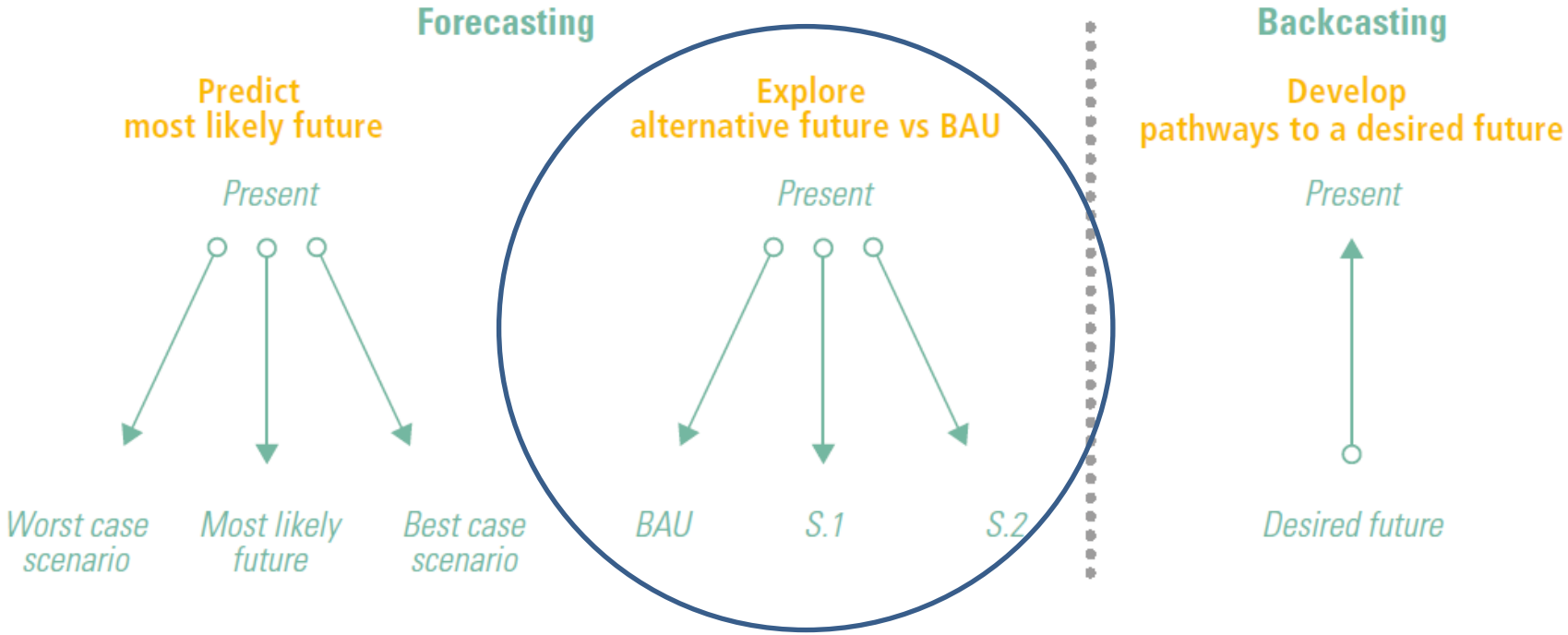
INRA, Paris, France

Policy, industry and society needs

- With global changes happening rapidly, the long-term consequences of policies are often unclear

- Numerous foresight studies on agriculture, food security and land use in past years

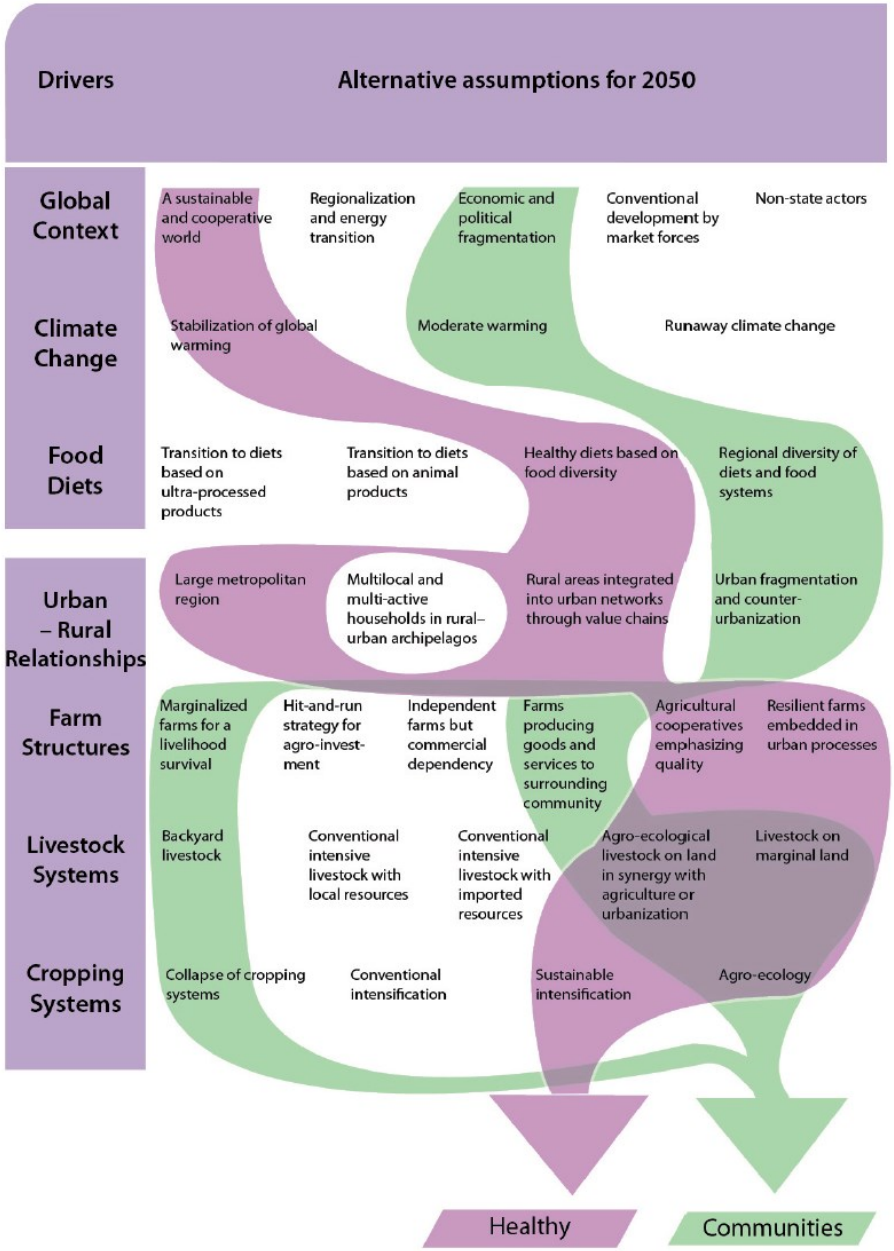
Foresight studies: explore alternative future vs. Business As Usual



(Ag. Transformation Pathways Initiative, 2016)

Figure 3. Drivers and alternative assumptions for 2050

Drivers	Alternative assumptions for 2050				
Global Context	Sustainable and cooperative world	Regionalization and energy transition	Economic and political fragmentation	Conventional development by market forces	Non-State actors
Climate Change	Stabilization of global warming		Moderate warming	Runaway climate change	
Food Diets	Transition to diets based on ultra-processed products	Transition to diets based on animal products	Healthy diets based on food diversity	Regional diversity of diets and food systems	
Urban – Rural Relationships	Large metropolitan region	Multilocal and multi-active households in rural–urban archipelagos	Rural areas integrated within urban networks through value chains	Urban fragmentation and counter-urbanization	
Farm Structures	Marginalized farms for a livelihood survival	Hit-and-run strategy for agro-investment	Independent farms but commercial dependency	Farms producing goods and services to surrounding community	Agricultural cooperatives emphasizing quality	Resilient farms embedded in urban processes
Livestock Systems	Backyard livestock	Conventional intensive livestock with local resources	Conventional intensive livestock with imported resources	Agro-ecological live -stock on land in sy- nergy with agriculture or urbanization	Livestock on marginal land
Cropping Systems	Collapse of cropping systems	Conventional intensification	Sustainable intensification	Agro-ecology	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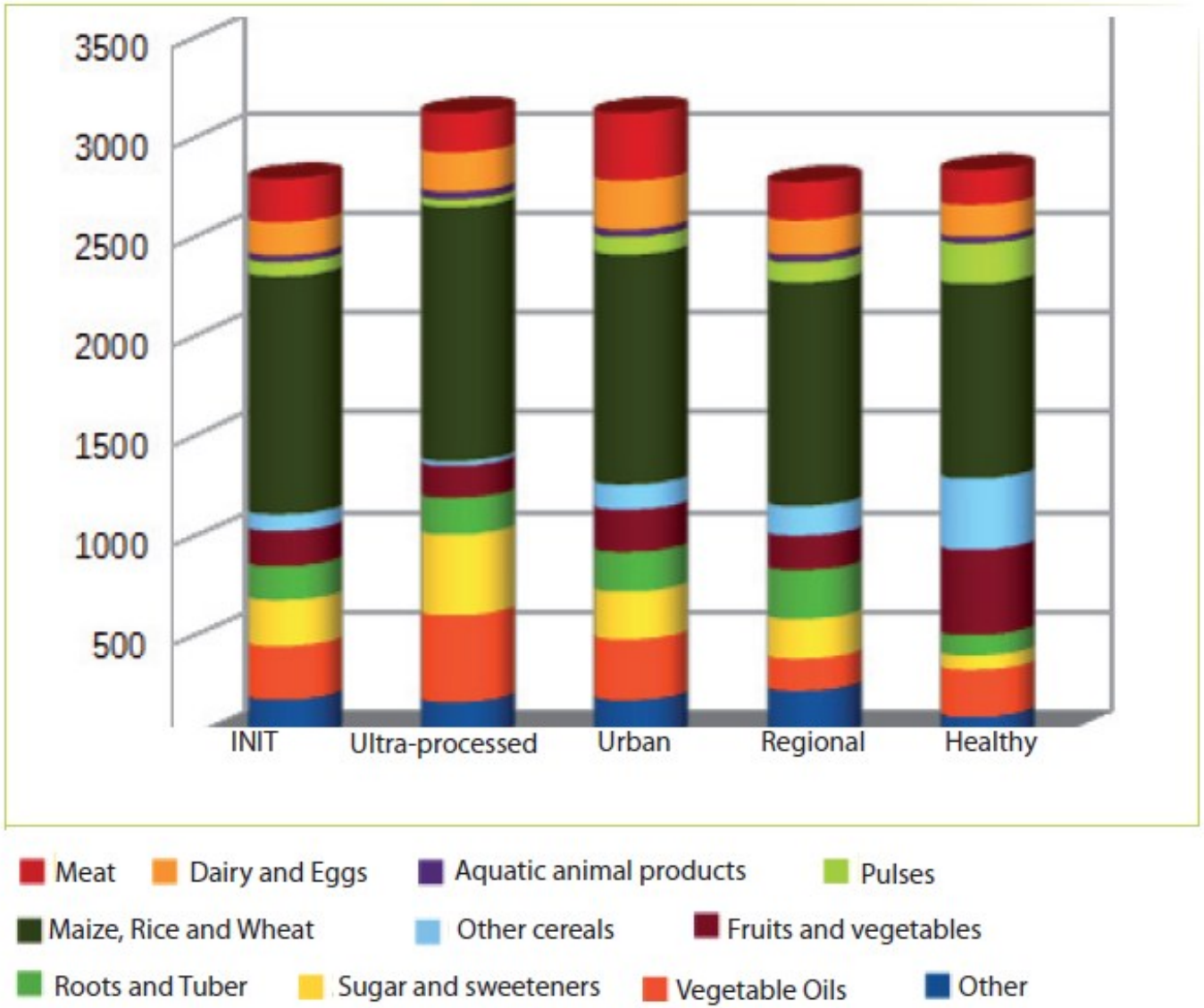
Cropping Systems
Collapse of cropping systems
Conventional intensification
Sustainable intensification
Agro-ecology
Healthy
Communities

Figure 4. Average world food diets in the initial 2010 situation and by 2050 under the various hypotheses for the futur of food diets(kcal/capita/day)



Policy, industry and society needs

- Numerous foresight studies in past years

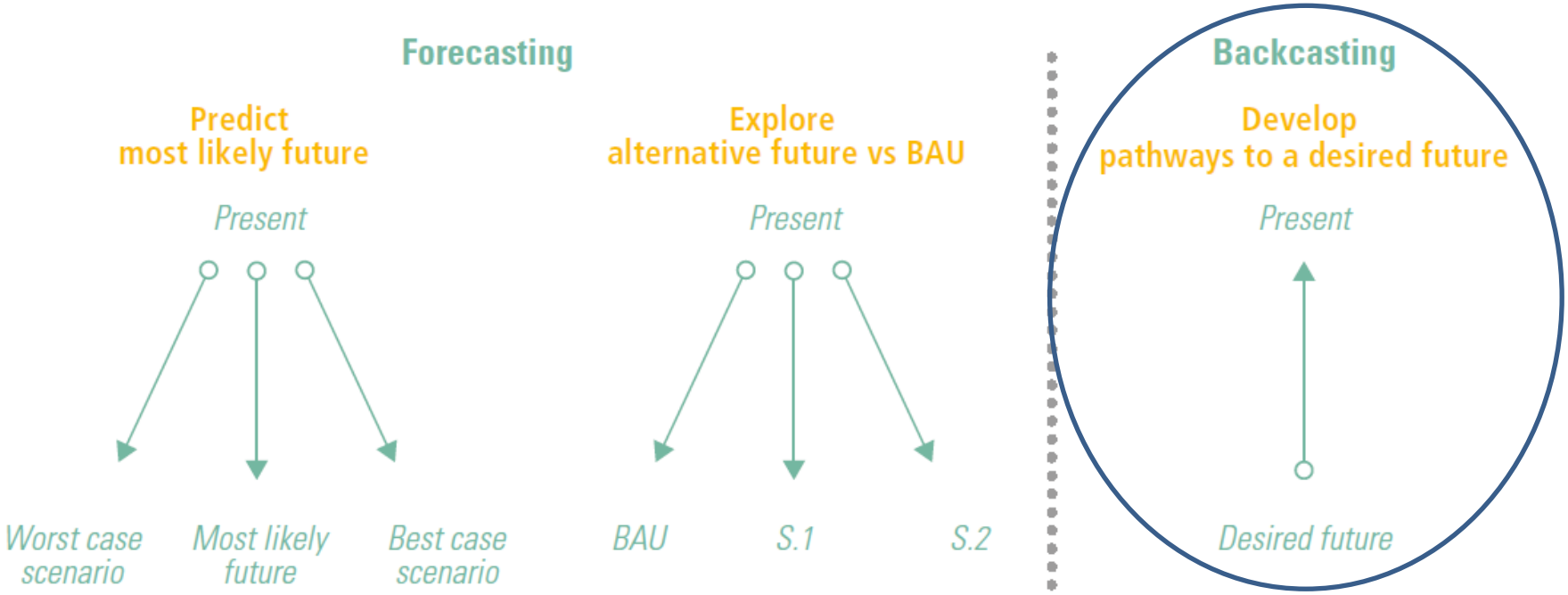
- Policy targets, industry targets and societal targets may differ

- However, there are universally agreed international targets:
  - Sustainable Development Goals (SDGs)
  - Paris agreement on climate (NDCs)

Agriculture and the SDGs

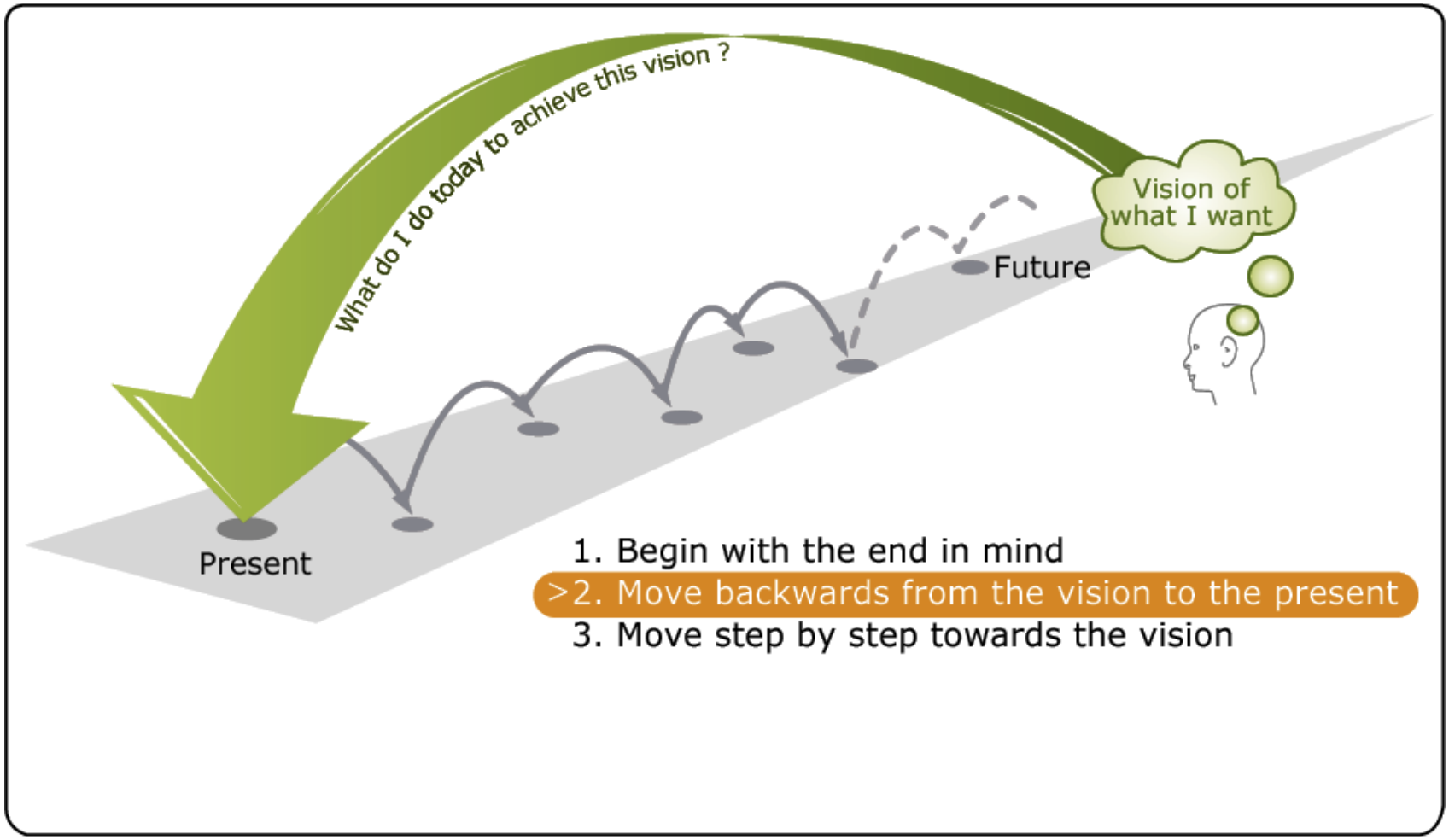
(FAO, 2016)

Developing pathways to a desired future



(Ag. Transformation Pathways Initiative, 2016)

Backcasting to reach sustainability targets



Some possible sustainability indicators for agriculture and food systems and corresponding SDGs

CATEGORY	Possible indicators	Dimension	SDG
OUTPUT	Total population, total food consumption, food consumption per capita, total food production, percentage of population below minimum level of dietary energy consumption, percentage of overweight and obese…	Food security and nutrition	SDG1, SDG2, SDG3, SDG12
	Agriculture and food chain GDP, farmers' income, proportion of farmers living poverty line, number of people active in agriculture and food chains…	Economic development, Poverty alleviation/ Resilience	SDG1, SDG8, SDG9, SDG10
WASTE	Food waste and losses as percentage of production	Efficiency	SDG2, SDG12
RESOURCES	Total agricultural area, agricultural land productivity, water use efficiency, nitrogen use efficiency, energy use efficiency…	Environment	SDG6, SDG7, SDG12, SDG13, SDG14, SDG15
WASTE	N and P losses from leaching and runoff	Environment	SDG2, SDG6, SDG12, SDG14, SDG15
POLLUTION	Net GHG emissions from the agricultural sector, degraded agricultural land, biodiversity loss, not collected solid farm waste (plastic etc.)	Environment	SDG2, SDG3, SDG6, SDG12, SDG13, SDG15

(Ag. Transformation Pathways Initiative, 2016)

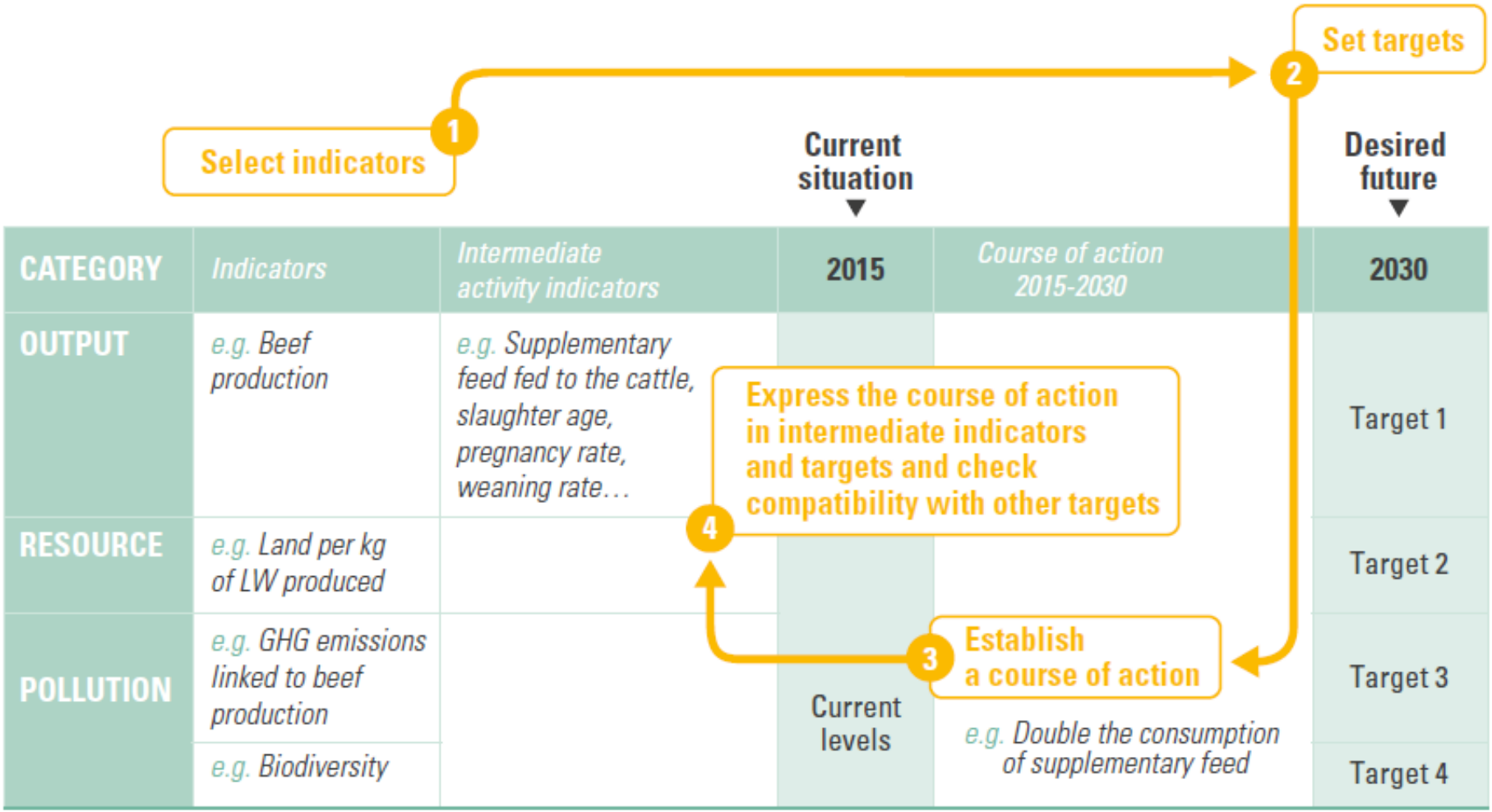
National targets (Uruguay)

Table 3. Environmental targets for Uruguay beef production addressing climate change, biodiversity and nitrogen pollution

Issue	Metrics	Baseline	Change	2030	Baseline to 2030
Production	kg LW/ha/year	102	↗ 25%	128	
Carbon footprint	kg CO_2/kg LW	20.8	↘ 25%	15.5	
Nitrogen	kg N/kg LW	66	↘ 27%	48	
Biodiversity	beef area (million ha)	11.1	→ ≈ 0%	11.1	

(Ag. Transformation Pathways Initiative, 2016)

The backcasting approach for agricultural transformation pathways



(Ag. Transformation Pathways Initiative, 2016)

Suggested strategy for the transformation of the beef sector in Uruguay

PRODUCTIVITY	BIODIVERSITY	CLIMATE	NUTRIENTS
Target +25% productivity at farm gate	**Target** Native forest conservation	**Target** -25% kg CO_2/kg LW	**Target** -27% kg N / kg LW
Roadblocks • Lack of technology transfer capacity • Lack of labor skills • Farmer attitude and age • Farm infrastructure and water access R&D	**Roadblocks** • Stakeholders interests • Knowledge adoption and diffusion • R&D	**Roadblocks** • R & D • Cultural factors such as breed preference • Lack of financial incentives • Knowledge adoption and diffusion • Farmer training	**Roadblocks** • Enforcement of existing regulations • Knowledge adoption and diffusion • Farmer training • Stakeholders interests • Inter-institutional coordination • R&D
Levers to overcome roadblocks • **Lever 1:** Inter-institutional framework for technology transfer • **Lever 2:** Training programs (farmers) • **Lever 3:** Incentives to improve infrastructure, adopt better management practices and reduce financial risks	**Levers** to overcome roadblocks • **Lever 1:** Forest law based on incentives (1987) • **Lever 2:** Grazing management practices • **Lever 3:** Stewardship and environmental values	**Levers** to overcome roadblocks • **Lever 1:** Research to improvefeed conversion efficiency (genetics) • **Lever 2:** Increased market reach and value for Uruguayan beef • **Lever 3:** Data on GHG emissions and carbon footprint.	**Levers** to overcome roadblocks • **Lever 1:** Regulations on water quality standards and soil use and management practices (Water and soils law - 1981) • **Lever 2:** Inter-institutional coordination on water quality at the watershed level • **Lever 3:** Farmer best management practices • **Lever 4:** Incentives for adoption of new technology

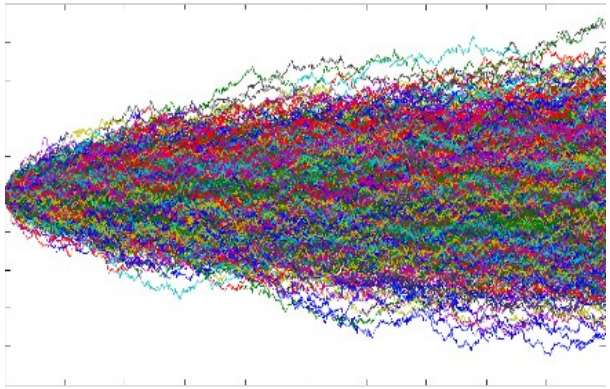
(Ag. Transformation Pathways Initiative, 2016)

Why are strategies not enough?

- Gaps and bias in national statistics

- Non intentional effects
and feedback loops

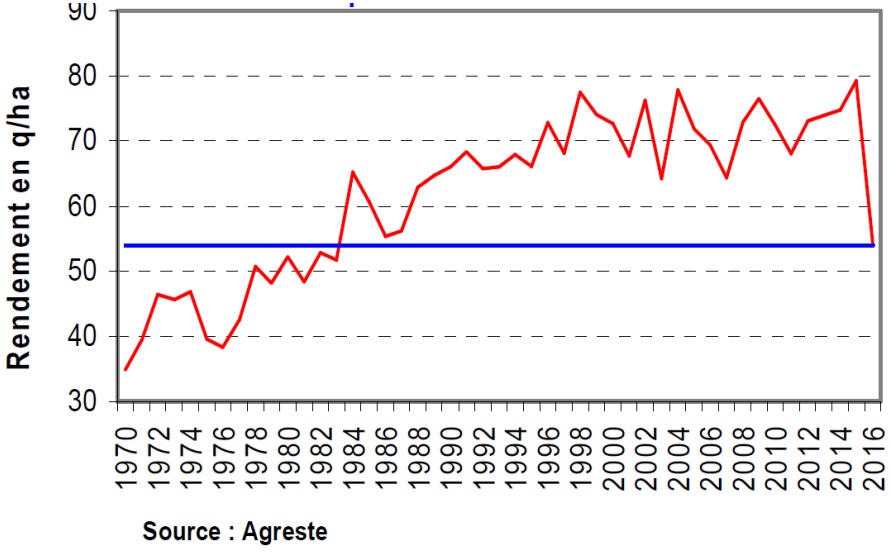
- Stochasticity (price volatility,
climatic variability, biotic risks)

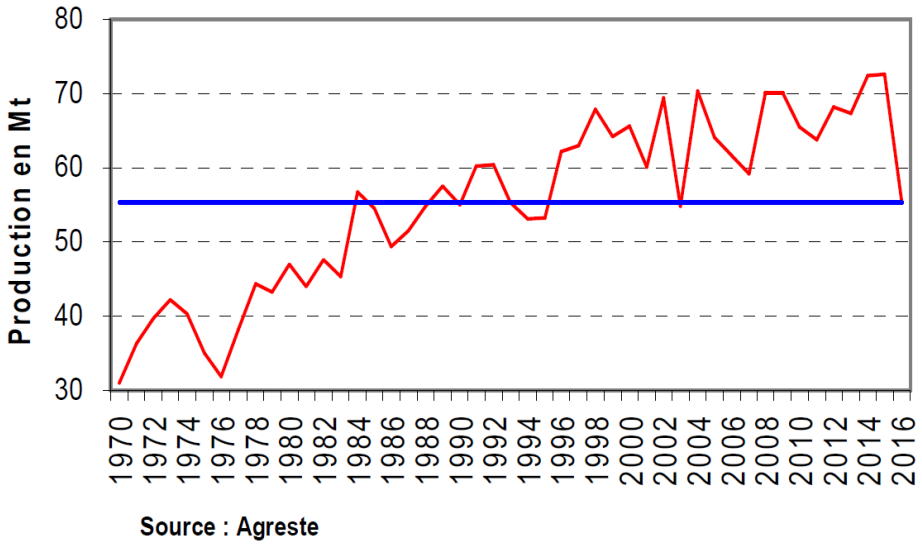


We need to monitor and assess changes

Wheather stochasticity: 2016 crop harvest in France

A 30% decline in wheat yield and a 20% drop in cereal production





A series of climate hazards:

Warm winter and early crop development

Cold during wheat flowering, impairing grain formation (meïosis)

Excess water in May-June: anoxic conditions and local flooding

Heavy fungal disease pressure, more fungicides used

Low solar radiation reducing grain filling

Heat and drought in July and August, affecting summer crops (e.g. corn)

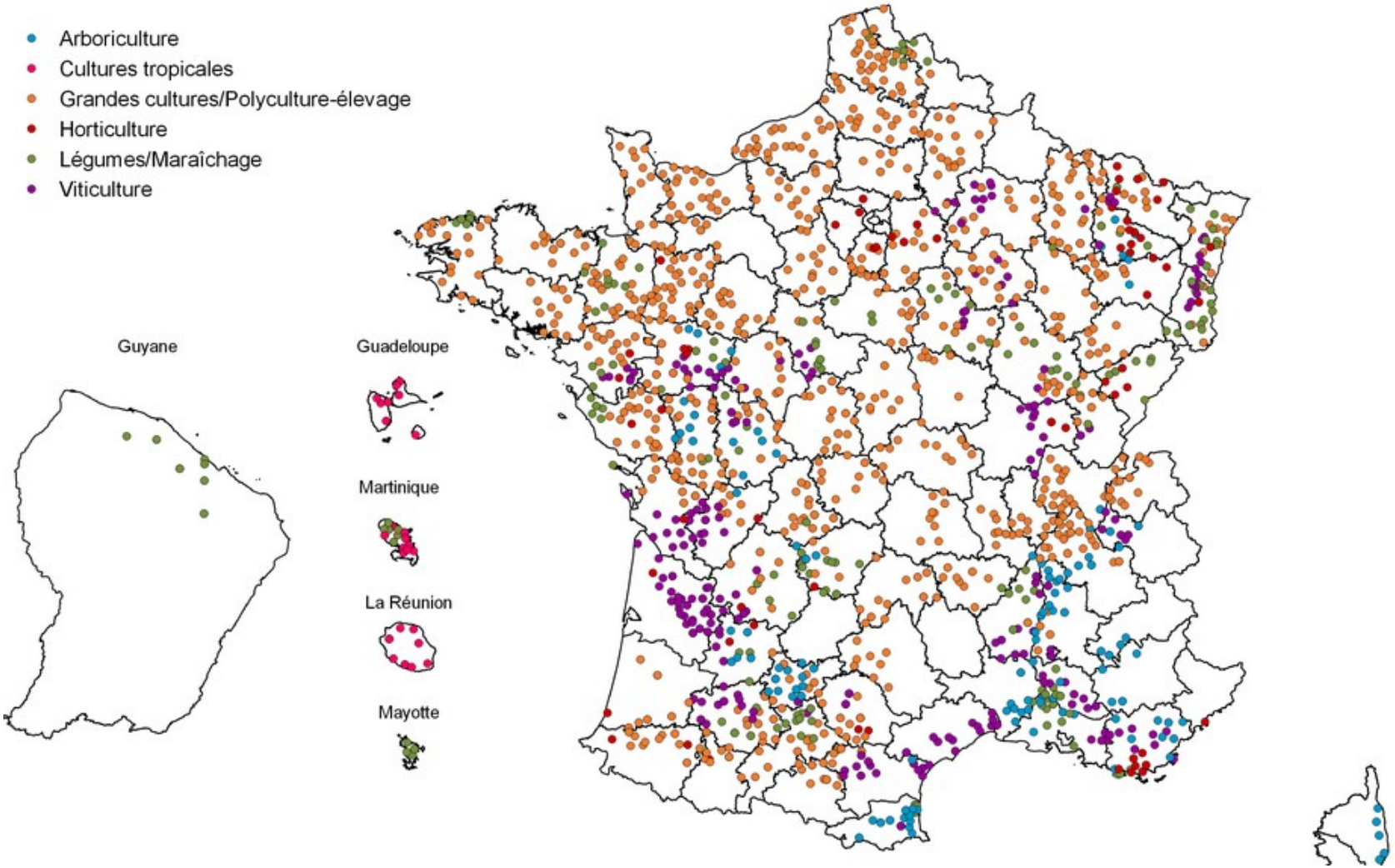
INRA SCIENCE & IMPACT

Matching climate change projections

Observational data: farm networks

French ‘Dephy’ farm network. Target: 50%reduction in pesticide use

Very few farms are successful (e.g. mixed crop/grass systems)



TempAg Priority Areas and Activities

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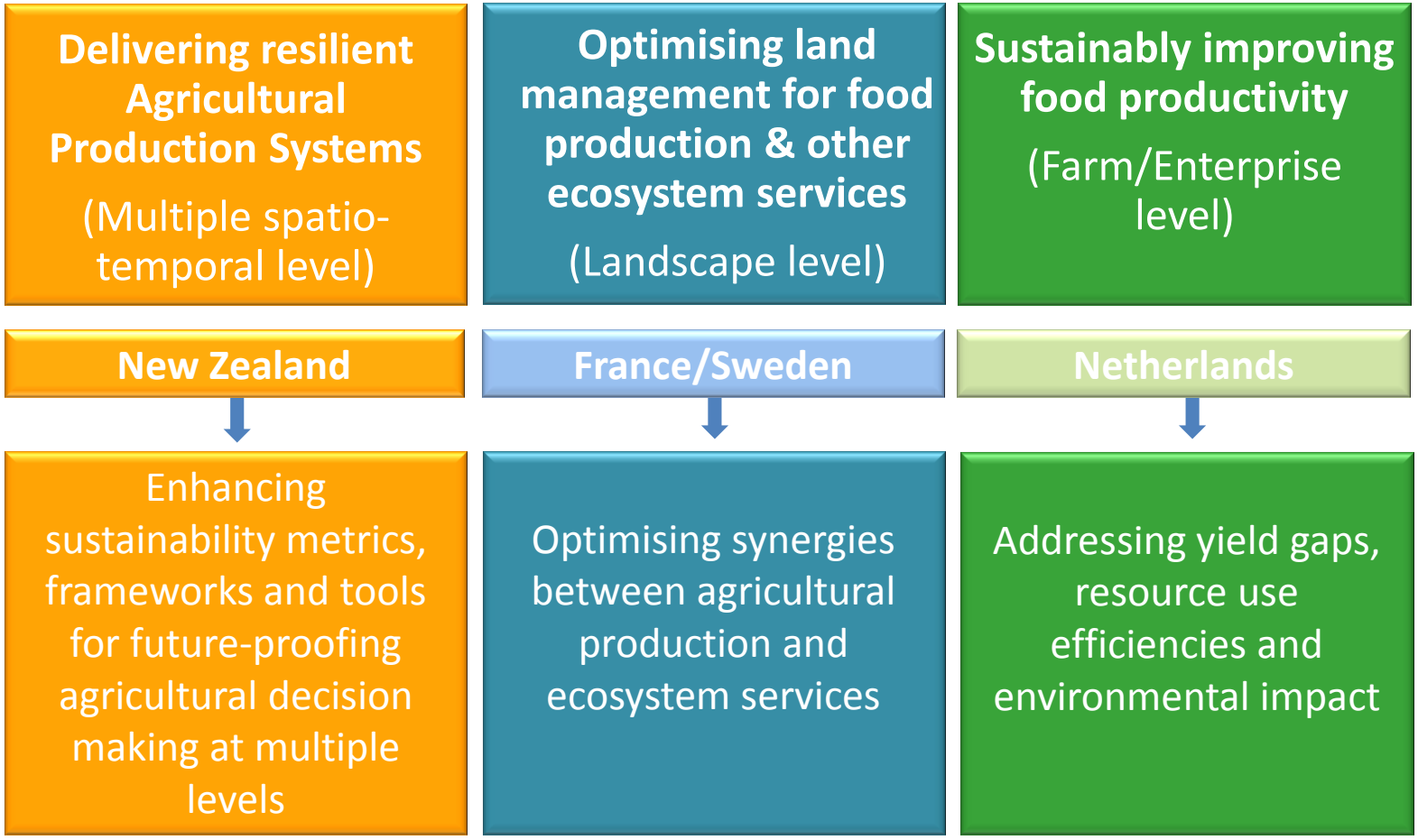

Policy, industry, society targets

Frameworks & metrics of sustainability

PA1, PA2, PA3

Observational data

Changes in performances

Assessments

Policy relevant conclusions and unknowns

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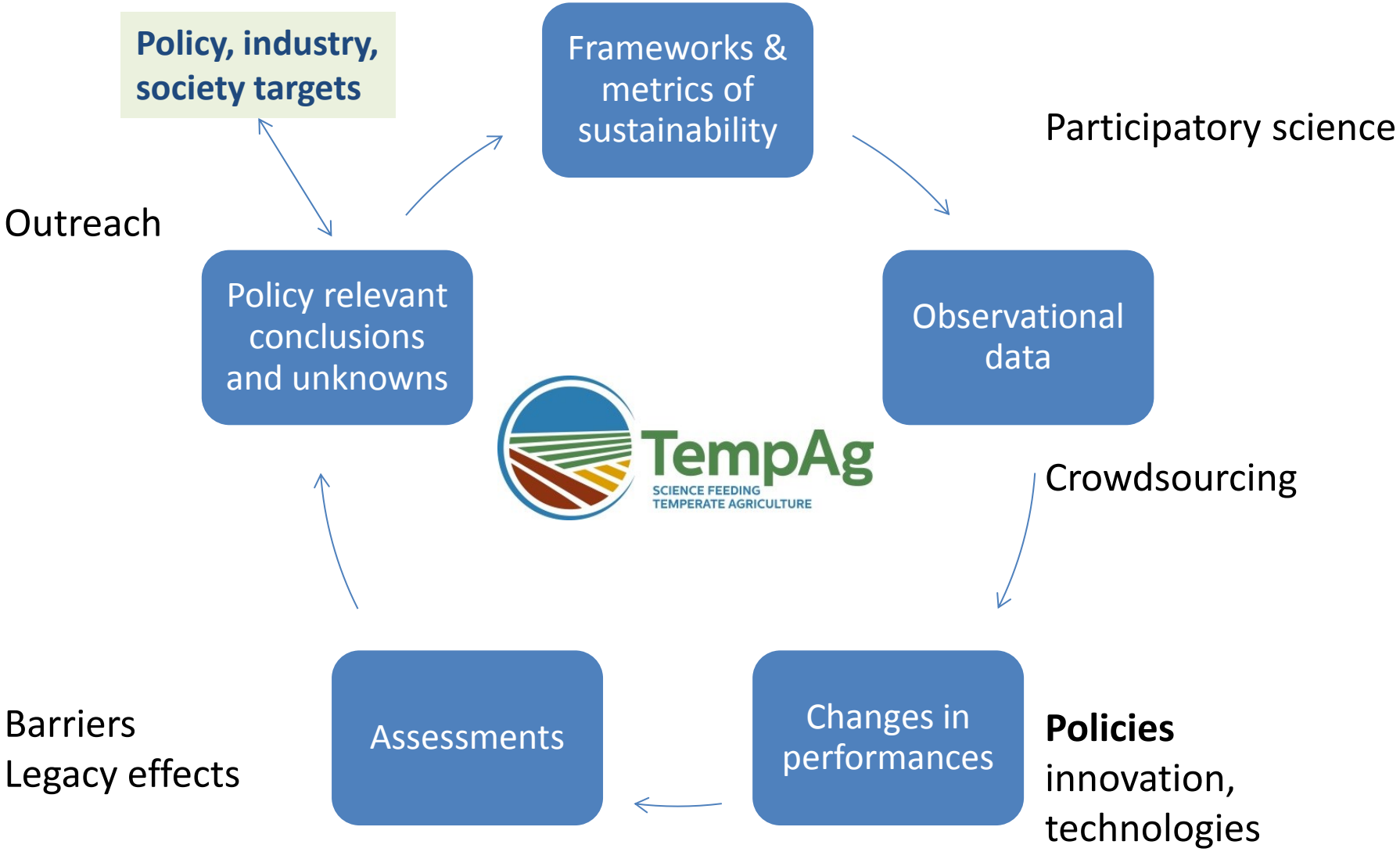
Policy, industry, society targets
Frameworks & metrics of sustainability
Participatory science
Outreach
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Observational data
TempAg
SCIENCE FEEDING TEMPERATE AGRICULTURE
Crowdsourcing
Barriers
Legacy effects
Assessments
Changes in performances
Policies
innovation, technologies

OECD network for farm-level analysis

FACCE JPI sustainable intensification network

Policy, industry, society targets

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Crowdsourcing

Risks (abiotic & biotic) and resilience

Barriers
Legacy effects

Assessments

Changes in performances

Policies, Innovation, Technologies,

Food losses & wastes

Thank you for your attention!

Global Food Security

Sustainable, healthy food for all

What is needed to make temperate food systems sustainable?

Tim Benton

UK Champion for Global Food Security & Professor of Ecology, University of Leeds

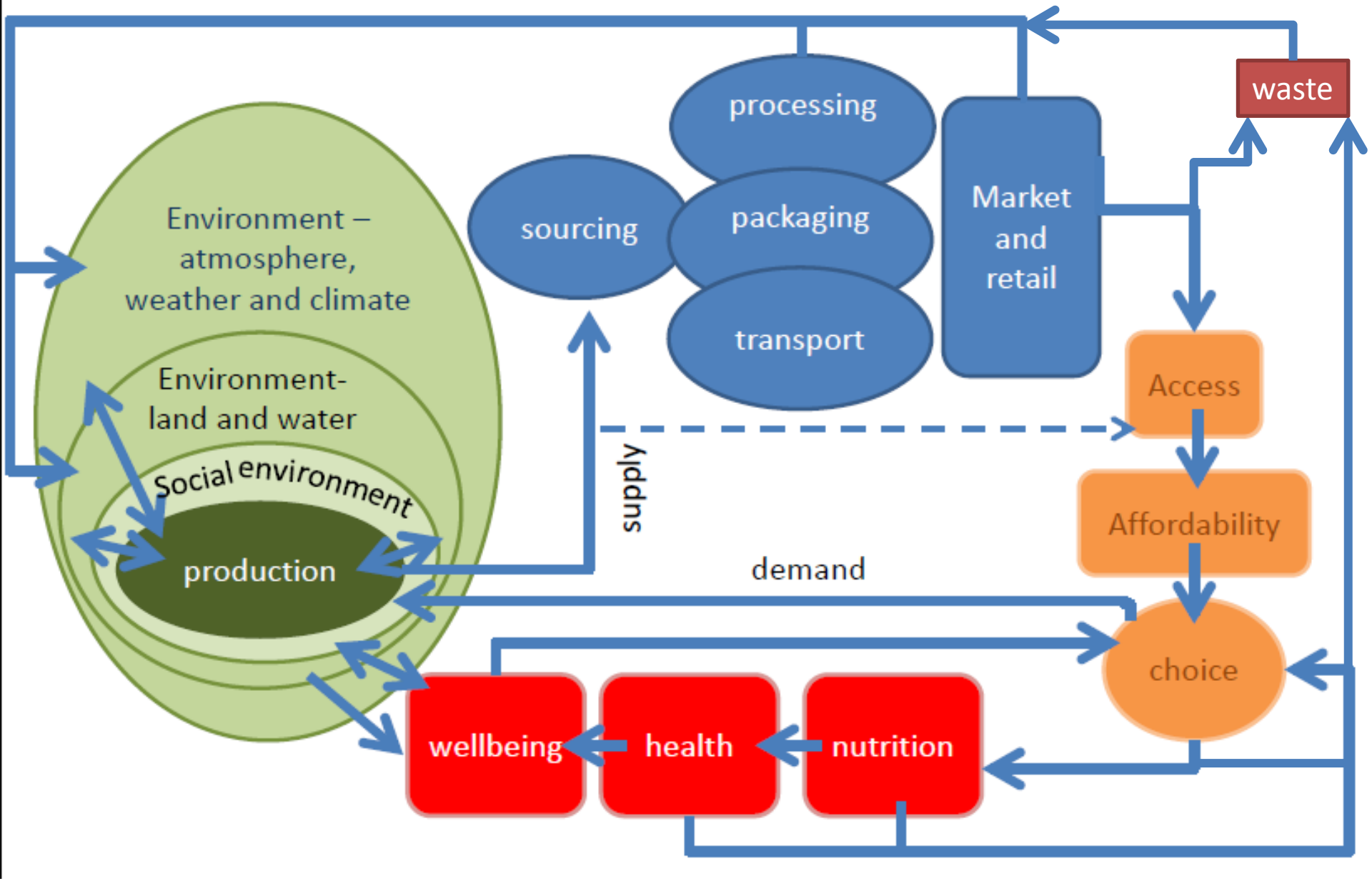
tim.benton@foodsecurity.ac.uk

@timgbenton

Global Food Security

Sustainable, healthy food for all

THE FOOD SYSTEM AND SYSTEMIC RISK



Sustainability implies consideration of health & wellbeing in “social dimension”

Evolving challenges

BAU

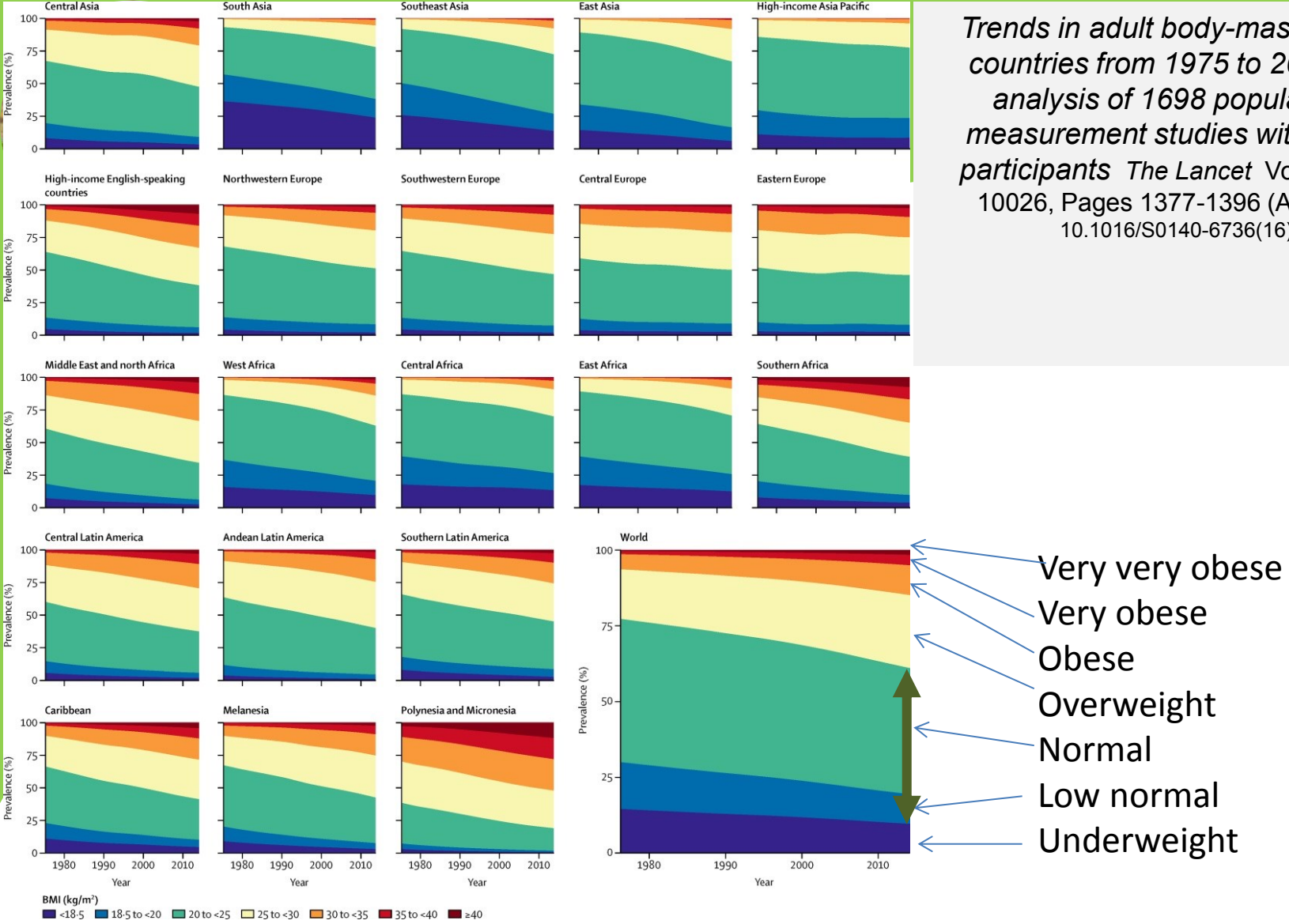
- Continuing trends for “ever more, ever more cheaply”
- Lots more food; more waste and ill health
- Needs more water
- Causes more climate change
- Creates greater need for BECCS
- More competition for land, water, energy, inputs
- Less biodiv, more uniformity, erosion of soils and natural capital
- Less resilience to perturbations here or in markets

Utopia

- Global move towards “sustainable nutrition” and low waste
- Different diets causing more diversified ag; more circular ag
- More multi-functional landscapes
- Efficient food system makes spaces for BECCS
- More rural employment
- More resilient landscapes, UK food system more resilient to market perturbations

????

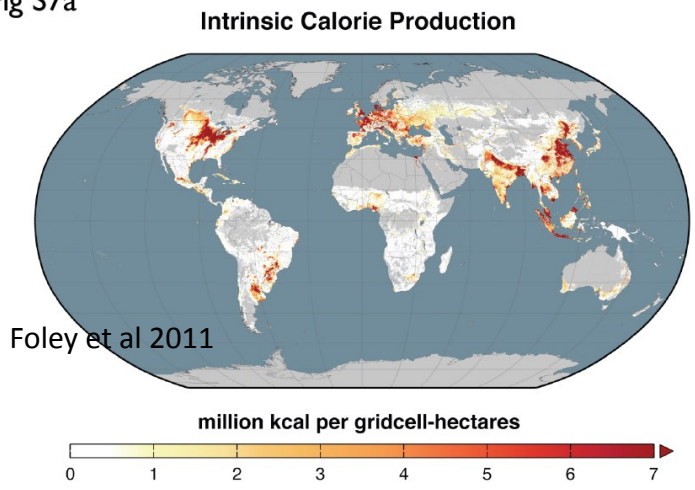
Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19·2 million participants *The Lancet* Volume 387, Issue 10026, Pages 1377-1396 (April 2016) DOI: 10.1016/S0140-6736(16)30054-X



Very very obese
Very obese
Obese
Overweight
Normal
Low normal
Underweight

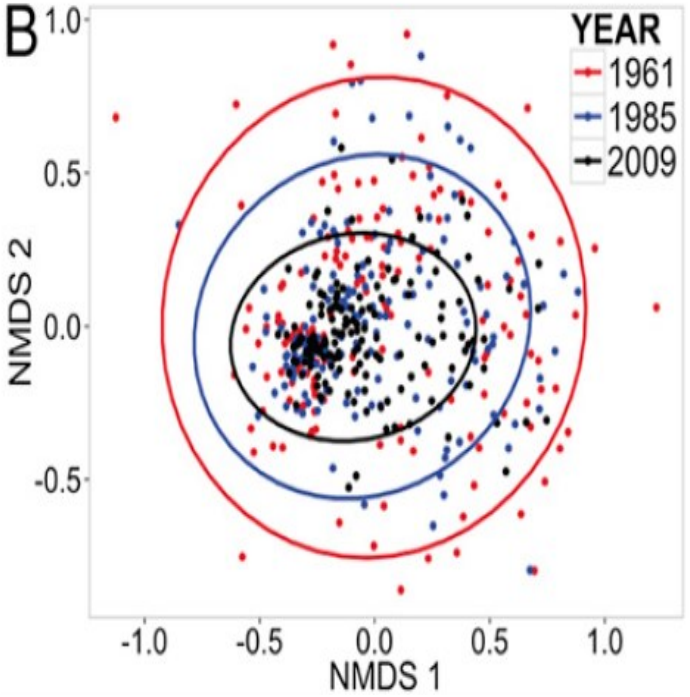
Trends in age-standardised prevalence of BMI categories in women by region

Global homogenisation: concentration of production



Foley et al 2011

Statistical "map" of global diets



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

Colin K. Khoury[a,b,1], Anne D. Bjorkman[c,d], Hannes Dempewolf[d,e,f], Julian Ramirez-Villegas[a,g,h], Luigi Guarino[f], Andy Jarvis[a,g], Loren H. Rieseberg[d,e,i], and Paul C. Struik[b]

www.pnas.org/cgi/doi/10.1073/pnas.1313490111

Nearly 2/3 of the world's calories come from wheat, rice and maize; 86% comes from wheat, rice , maize, sugar, barley, soy, palm, potato

Global connectivity through trade has benefits but carries risks

Puma et al 2015

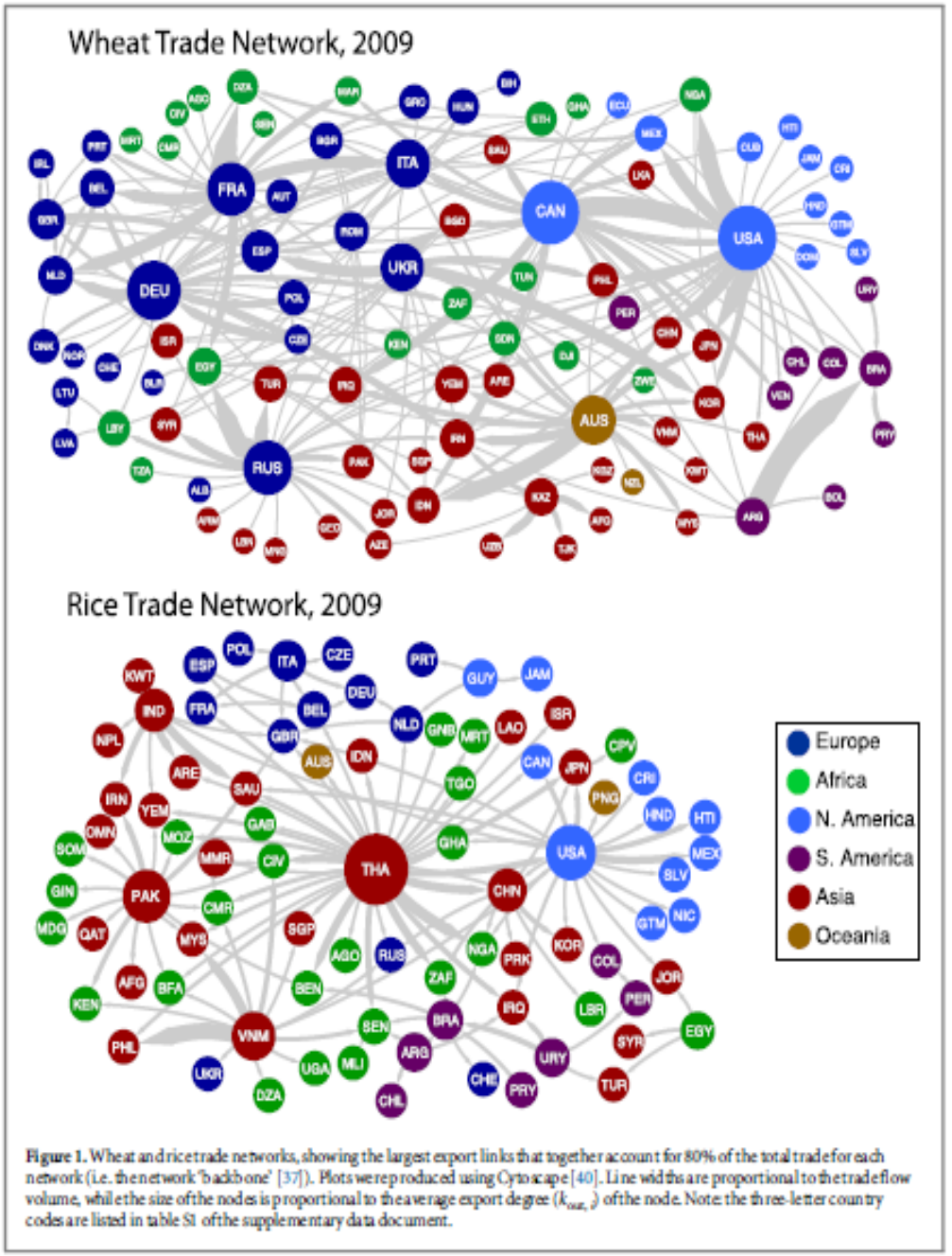


Figure 1. Wheat and rice trade networks, showing the largest export links that together account for 80% of the total trade for each network (i.e. the network 'backbone' [37]). Plots were reproduced using Cytoscape [40]. Line widths are proportional to the trade flow volume, while the size of the nodes is proportional to the average export degree ($k_{out,i}$) of the node. Note: the three-letter country codes are listed in table S1 of the supplementary data document.

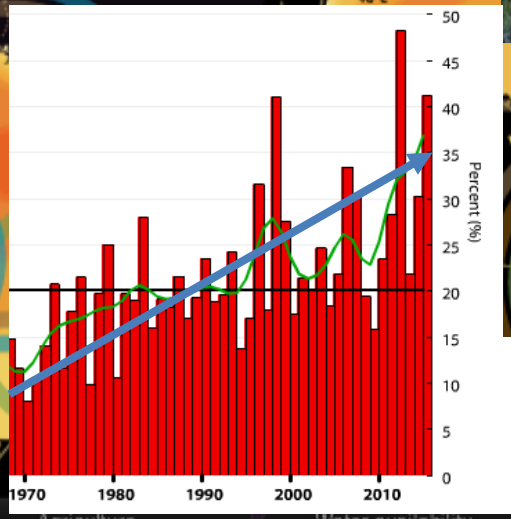
Supply chain logistics: risks and resilience

courtesy of http://rsif.royalsocietypublishing.org/content/early/2010/01/19/rsif.2009.0495.full

Met Office

The impact of a global temperature rise of 4°C (7 °F)

HM Government



Climate Extremes Index

Contiguous U.S. CEI (All Steps Combined)
Annual (January-December) 1910-2015

9-Point Binomial Filter
Mean
Actual Percent

The Amazon Forest ▲ | Agriculture ▲ | Water availability ▲ | Sea-level rise ▲ | Carbon cycle ▲ | Temperature rises

Crops | Water Availability | Sea Level Rise | Marine | Drought | Permafrost | Tropical Cyclones | Extreme Temp | Health

+ °Celsius

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	4	5	7	9	11	13	14	16	18	20	22	23	25	27	29

+ °Fahrenheit

City populations
5-10 Million
10-20 Million

Source: UN Statistics Division Demographic Yearbook 2007

Credits

Environ. Res. Lett. 11 (2016) 055008 doi:10.1088/1748-9326/11/5/055008

Environmental Research Letters

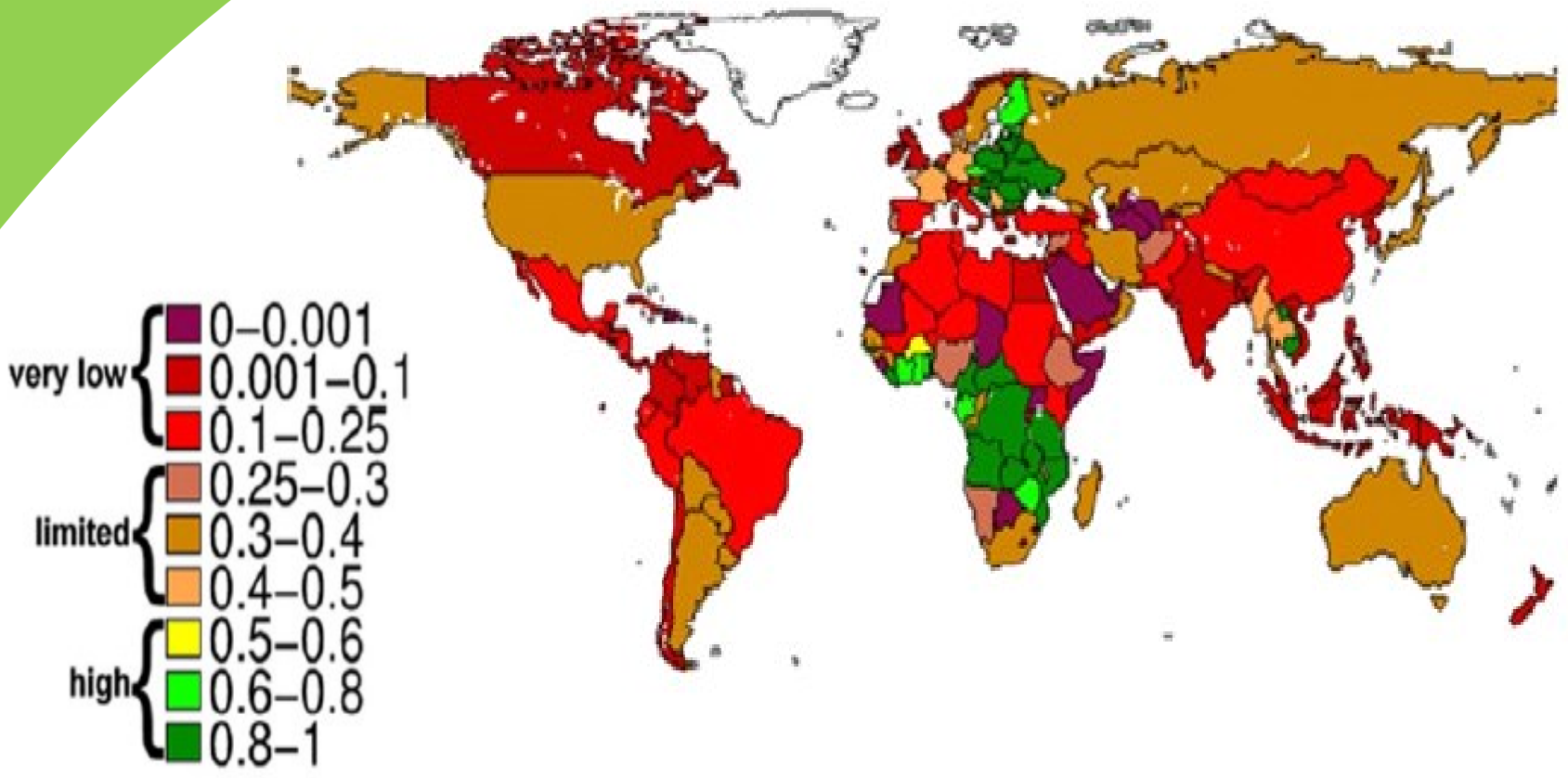
PAPER

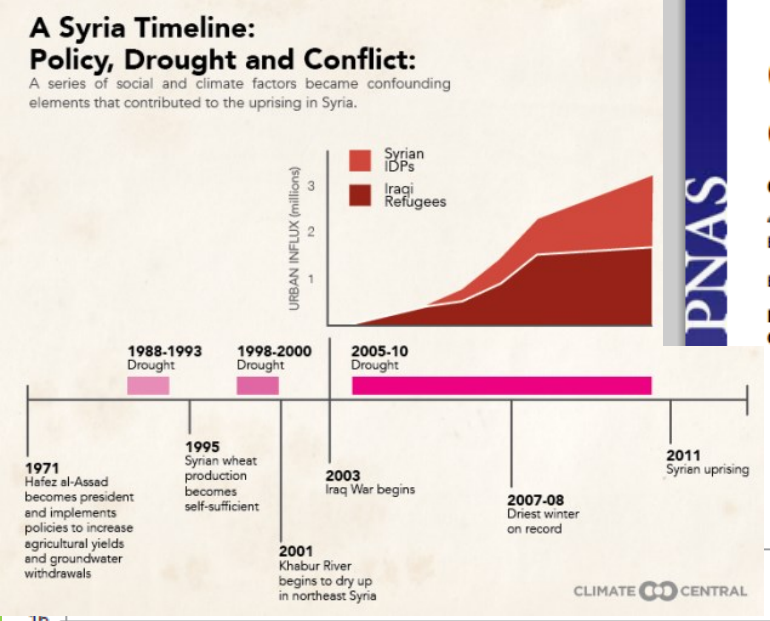
Past and present biophysical redundancy of countries as a buffer to changes in food supply

Marianela Fader[1], Maria Cristina Rulli[2], Joel Carr[3], Jampel Dell'Angelo[4], Paolo D'Odorico[3], Jessica A Gephart[3], Matti Kummu[5], Nicholas Magliocca[4], Miina Porkka[5], Christina Prell[6], Michael J Puma[7], Zak Ratajczak[3], David A Seekell[8], Samir Suweis[9] and Alessandro Tavoni[10]

...inable, healthy food for ...

Global and nation-state buffering capacity reducing





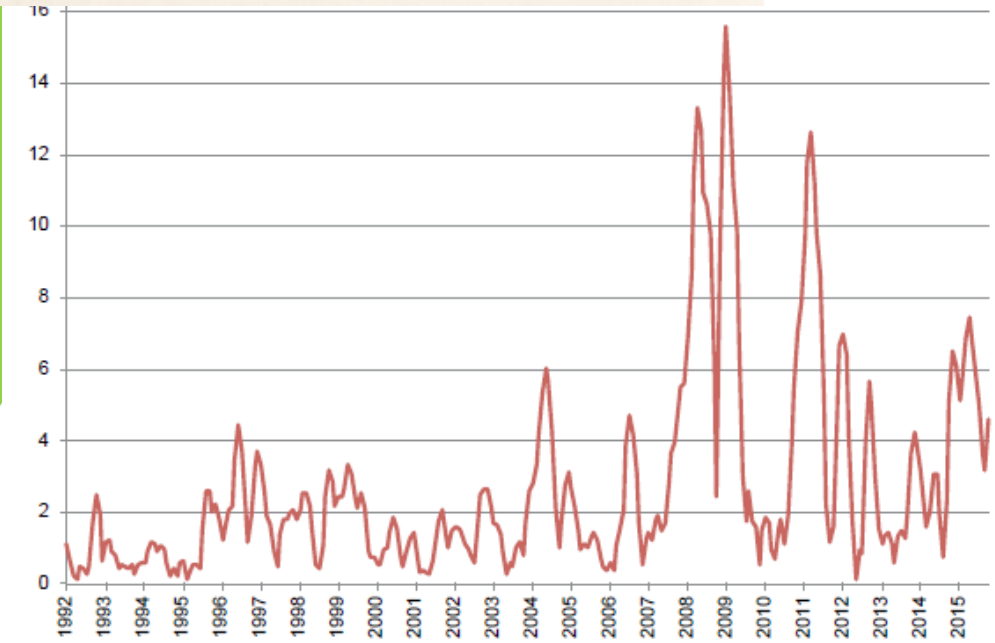


Figure 4: Relative standard deviations of monthly food price index from moving annual average, January 1991 to September 2015.

This figure is an update of the analysis done by Chatham House[10], realised with IMF Food price index data.[25]

PNAS

Climate change in the Fertile Crescent and implications of the recent Syrian drought

Colin P. Kelley[a,1], Shahrzad Mohtadi[b], Mark A. Cane[c], Richard Seager[c], and Yochanan Kushnir[c]

[a]University of California, Santa Barbara, CA 93106; [b]School of International and Public Affairs, Columbia University, New York, NY 10027; and [c]Lamont–Doherty Earth Observatory, Columbia University, Palisades, NY 10964

Edited by Brian John Hoskins, Imperial College London, London, United Kingdom, and approved January 30, 2015 (received for review November 16, 2014)

Before the Syrian uprising that began in 2011, the greater Fertile Crescent experienced the most severe drought in the instrumental

Syria's water security by exploiting limited land and water resources without regard for sustainability (10).

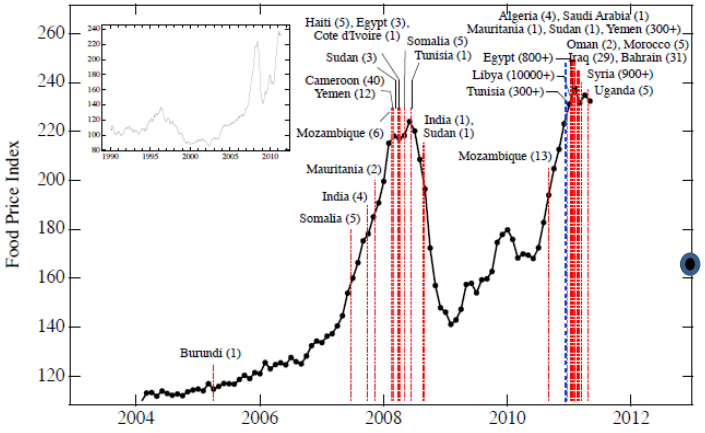
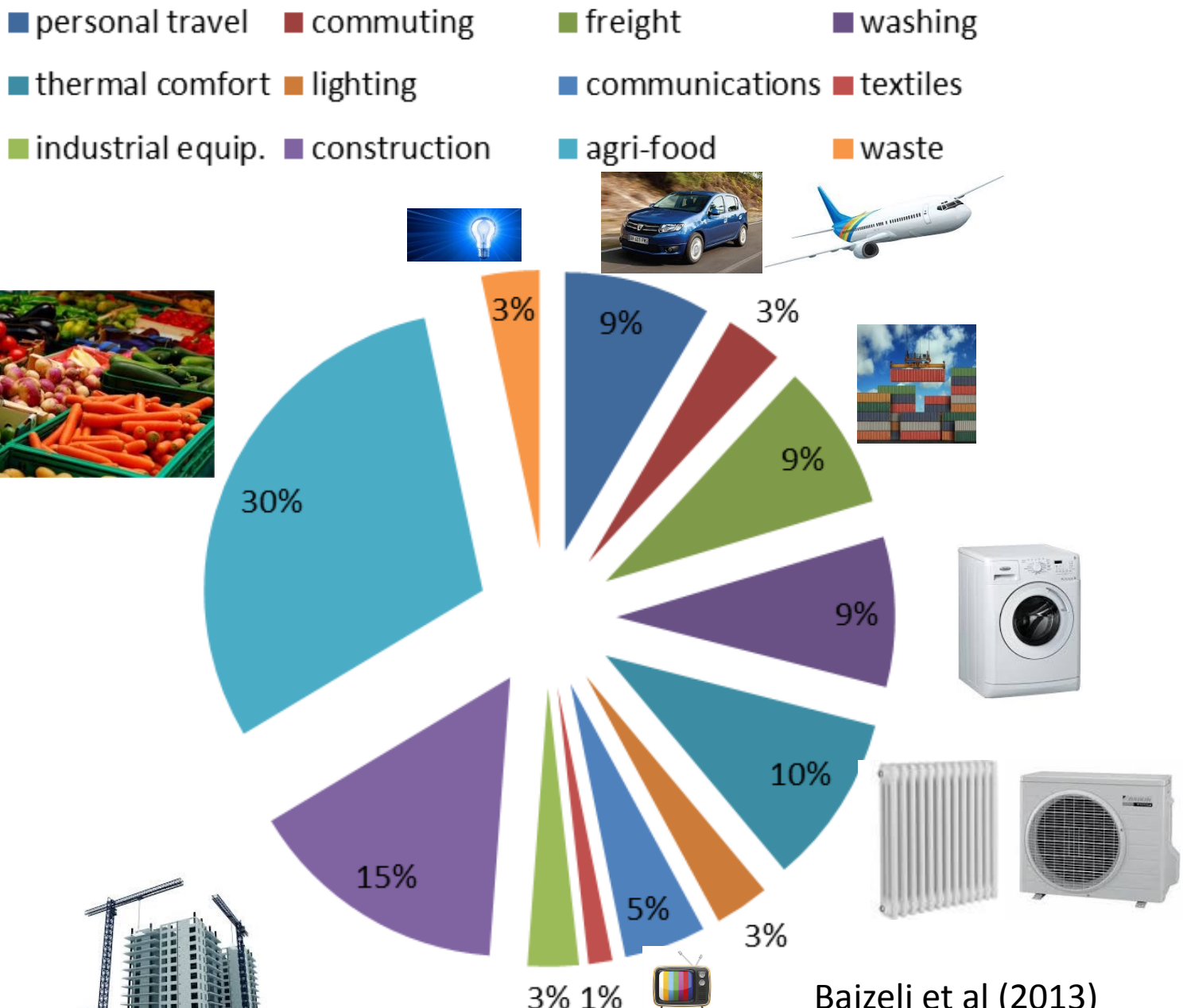


FIG. 1: Time dependence of FAO Food Price Index from January 2004 to May 2011. Red dashed vertical lines correspond to beginning dates of "food riots" and protests associated with the major recent unrest in North Africa and the Middle East. The overall death toll is reported in parentheses [26–55]. Blue vertical line indicates the date, December 13, 2010, on which we submitted a report to the U.S. government, warning of the link between food prices, social unrest and political instability [56]. Inset shows FAO Food Price Index from 1990 to 2011.

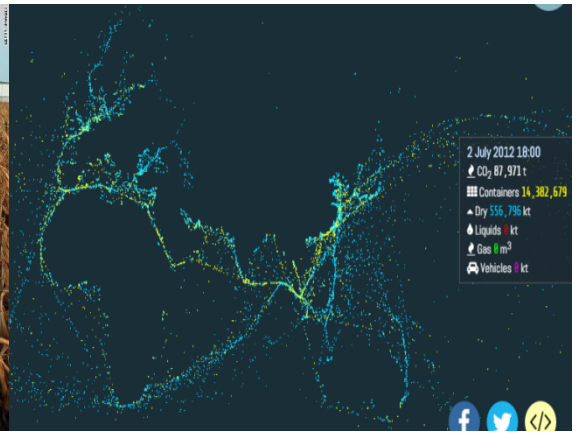
GHG emissions by service (50.6 Gt CO2e total)



Baizeli et al (2013)

Global Food Security

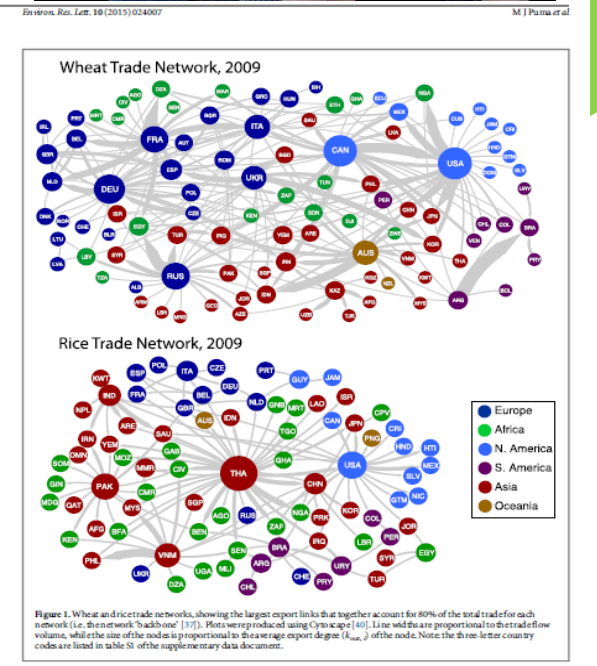
Sustainable, healthy food for all



PRIORITIES AND GAPS

Managing the “nexus”

Sustainability is about maintaining ecosystem services at a global and local scale appropriate to place, societal needs and ethical values



Climate change, biodiversity loss, soil degradation, NCD epidemic etc indicate degrees of market failure through externalising costs

Drivers for change

- Pressure on natural resources (soil+"nexus", tipping points)
- Food-related ill health (nutrition, safety, authenticity; AMR)
- Changing patterns of weather and need for resilience
- Systemic risk of global supply; pests and diseases
- Consumer-led drives for "sustainable healthy diets"
- Paris climate agreement

Issues and responses

Issue	Potential response
Poverty/obesity/NCDS	Urban food environments Changing diets
Changing weather patterns	Understanding risks Resilience of management Diversified production Supply chain logistics and diversified supply chains
Climate mitigation	Increasing efficiency; carbon storage Changing diets
Nexus management	“joined up” land use planning; understanding scale
Limits	Tipping points and local/planetary boundaries

Issue	Potential response
Alternative futures	Scenarios and horizon scanning; Food systems modelling
Dietary demand change and how it impacts agriculture	Alternative crops and systems; “post-pesticides” vs “techno-diets”; waste
Pests and diseases	AMR; globalised pests; food fraud
Nexus management	“joined up” land use planning
Currently projected demand	Intensification
SI	Precision ag; modern biotech; extensive farming systems

Further needs

- Coordination among funders
  - G20 research prioritisation
  - Alignment of investments
  - Shared knowledge, data , infrastructure
- Visibility
  - To funders
  - To political system (G20 MACS)
  - Global reach

Global Food Security

Sustainable, healthy food for all

Thank you!

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Federal Ministry of Food and Agriculture

THÜNEN

Global FLW Research Platform – lessons learned & how to shape MACS collaboration beyond 2017

Xi'an, May 30th, 2016

Outline

- ➡ Global FLW Research Platform: Context – Objectives - Implementation
- ➡ Outlook I: Completion of Global FLW Research Platform by MACS
- ➡ Outlook II: MACS Consolidation
- ➡ Outlook III: Preparation of German G20 presidency 2017

www.global-flw-research.org – MACS driven Global FLW Research Platform

Context: task referring to MACS Communiqué 2015:

- Preliminary mapping of existing science & technology activities related to FLW (managed by Germany plus several G20 countries)
- Coordination of MACS mapping with “Technical Platform on the Measurement and Reduction of Food Loss & Waste“ (FAO)

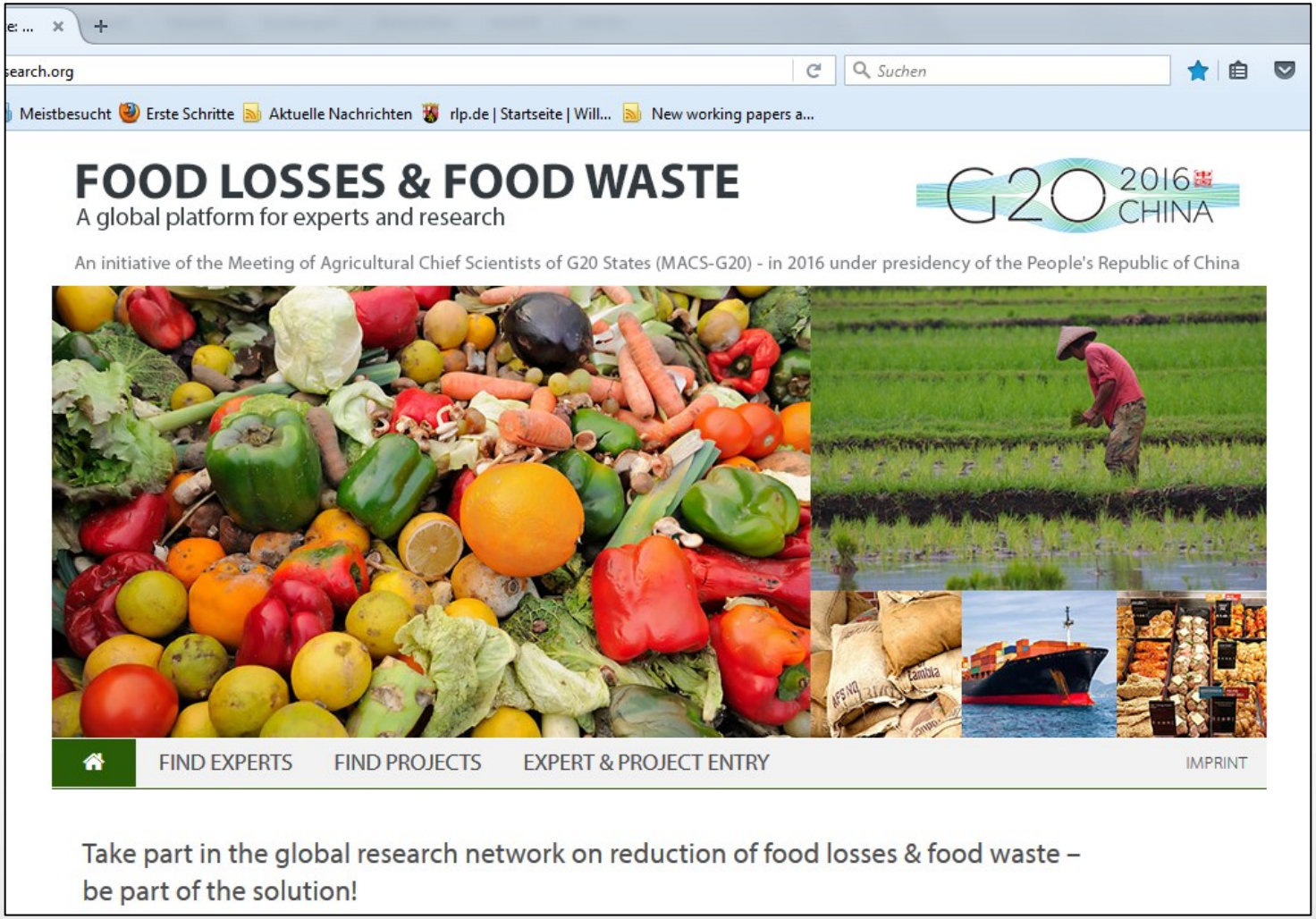
Primary objective of MACS mapping on FLW:

- Providing a survey on existing FLW research activities as contribution to
  - enhanced information sharing
  - coherent coordination of potential joint MACS/G20 activities in the future

Global FLW Research Platform – Features

- **Usable in the long term** 
- **Online-tool with versatile functions** 
- **Recording FLW projects + experts** 
- **Global approach** 

Global FLW Research Platform: www.global-flw-research.org – Implementation



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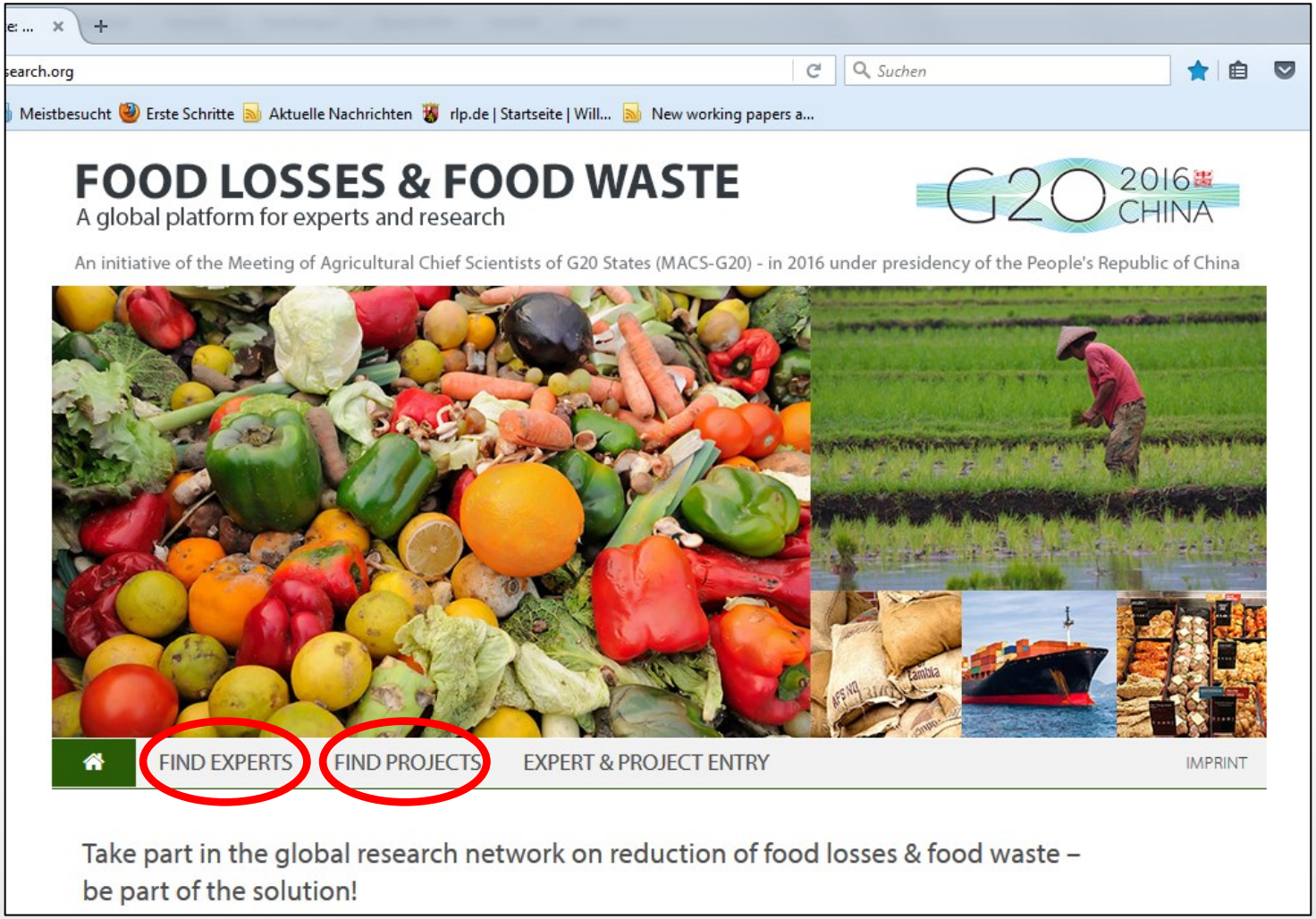
Global FLW Research Platform – Implementation



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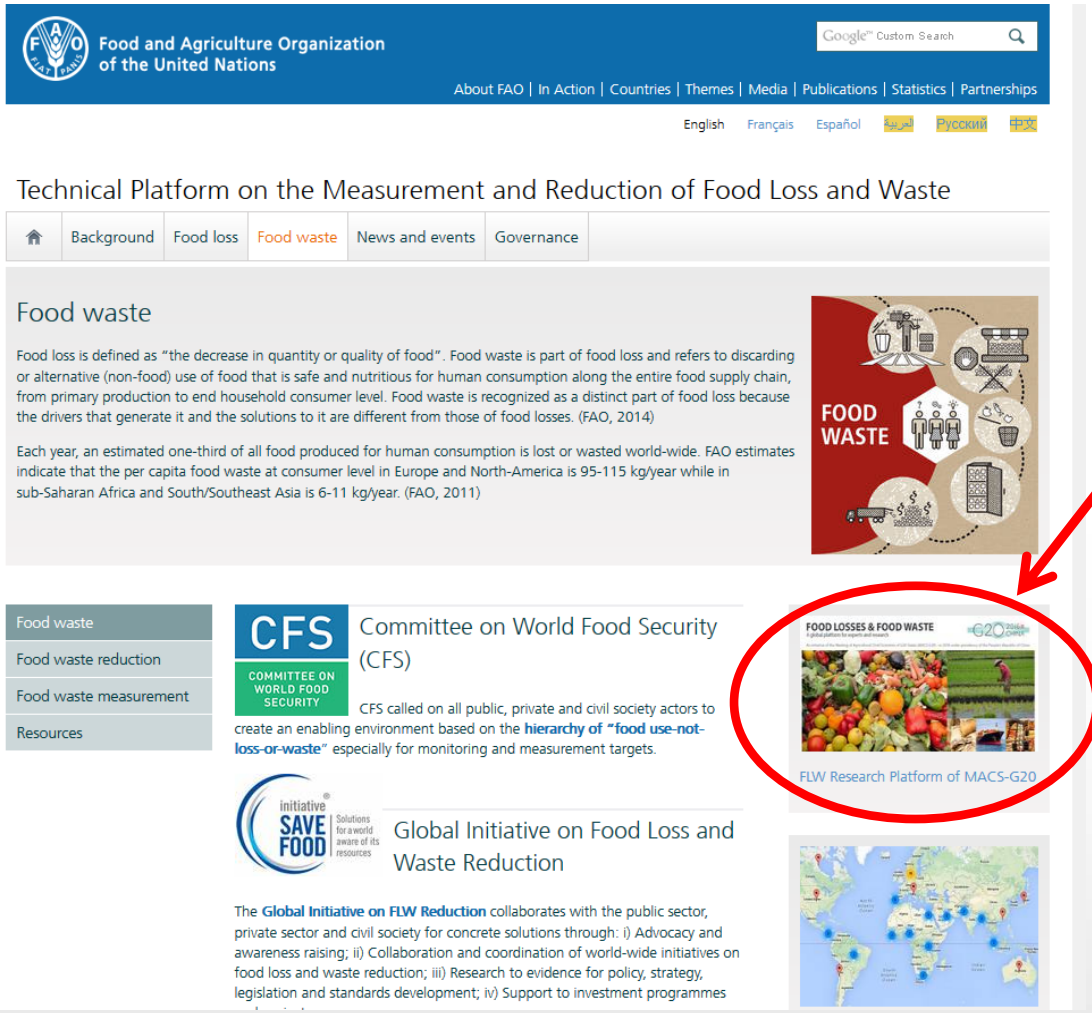
Linkages of www.global-flw-research.org



- **Existing linkage to:**

  „Technical Platform on the Measurement and Reduction of Food Loss and Waste" of FAO

- **further linkages scheduled**

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Outlook I:
Completion of www.global-flw-research.org

Challenge: A single country can‘t complete FLW platform globally & keep it up-to-date!

Conclusion: We need interaction & collaboration across countries & regions!

Solution:

➡ **Germany guides voluntary group of „FLW focus countries“ which mobilise countries/partners in their respective region to feed into *www-global-flw-research.org***

➡ **Regions:** **- Europe** (volunteer: Germany)
- Volunteers needed for:

South America, Northern & Central America,

Middle East / South-Eastern Asia,

Far East, Africa, Oceania

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Outlook II: MACS consolidation

Global FLW Research Platform

= only one example for a promising collaboration approach under the auspices of MACS

Since 2012 MACS has processed further key activities ("work packages"):

- agricultural productivity and sustainability
- sharing research priorities and prioritisation models
- working group on animal diseases and high priority vaccines

Challenge:

Need to consolidate MACS format itself (including existing work packages)

Outlook II: MACS consolidation

Entry point:

- Pre-condition for successful MACS activities – joint vision & strategic approach (feeding into overall G20 process & linking agricultural science policy and practice)

MACS should strive for 3 primary goals related to agricultural research, science & innovation under G20:

1. Being a key "katalyst" & "facilitator "of decisions made by G20 Agricultural Ministers, together with international organizations
2. Providing an enabling framework & suitable mechanisms for mutually agreed joint activities ("work packages")
3. Building on existing successful initiatives to establish "Global Research Collaboration Platform" (GRCP) models over time

Outlook III:
Preparation of German G20 presidency

Key Topic for MACS/G20 & GFFA 2017 in GER:

„Agriculture & Water“

Linkages with previous & current MACS topics:

- Efficient water use - crucial for *“Transformational productivity & sustainability lift” (2014)*
- Loss of 300 km3 irrigation water per annum due to *“Food Losses & Waste“ (2015)*
- Dealing with water scarcities and contaminations requires *“Technology, Innovation & Knowledge Sharing” (2016)*

Upcoming „water“ initiatives could build on existing MACS activities

Outlook III:
German G20 presidency 2017 – ideas for MACS

MACS related activities planned for 2017:

- Continued maintenance and completion of Global FLW Research Platform; using FLW platform as a building block („pilot“) for broader GRCP approach
- Workshop on joint FLW action & way forward – see above *(prior to MACS 2017)*
- Workshop „Open Data for Agriculture and Nutrition” – conducted by Association for Technology and Structures in Agriculture (KTBL) in collaboration with GODAN *(March/April 2017);* consideration of potential linkages with other G20 initiatives
- MACS 2017 (dates tbc): progress made & way forward

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Contact:

Welcome to MACS 2017 in Germany!

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