Research needs for sustainable food systems – concepts and priorities

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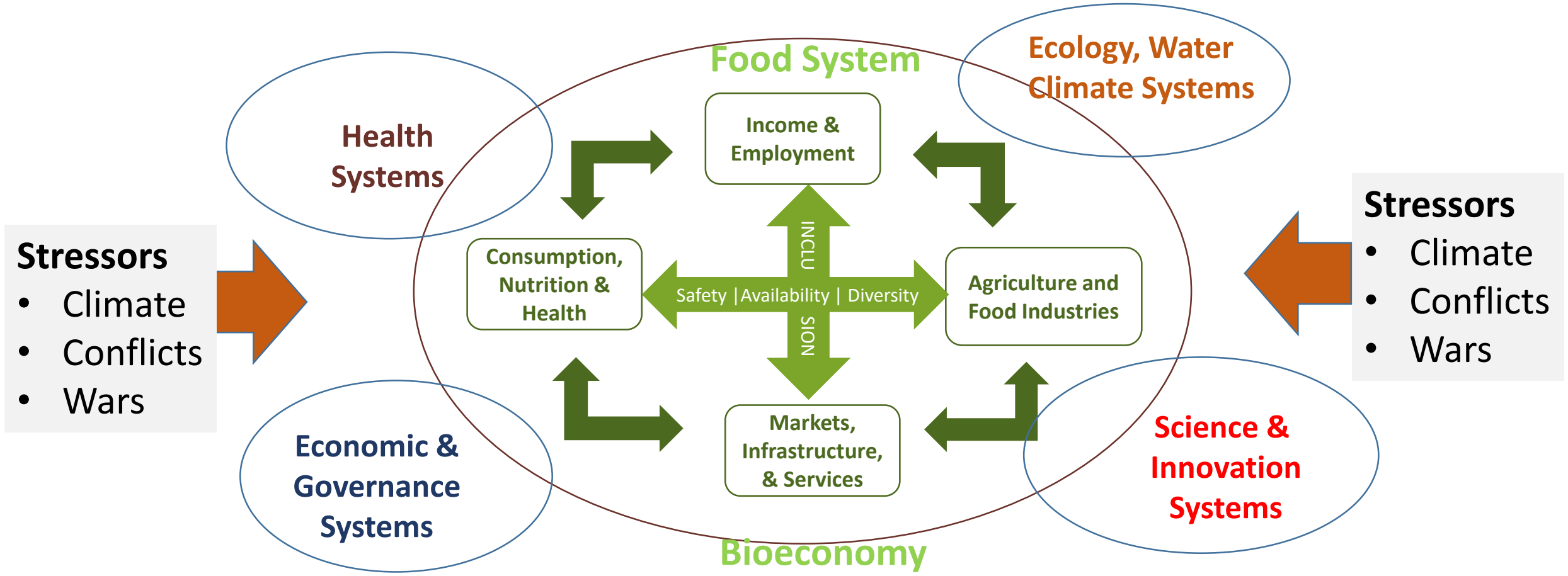
International Expert Consultation on *Research needs and priorities for the transformation to Sustainable Food Systems at European and global level*
by SCAR ARCH, FOOD SYSTEMS and BIOECONOMY SWGs
23, 24 and 25 January, 2024

Overview

1. **Food systems concept**
2. Agrifood system challenges – People & Planet
3. Priority research for food and nutrition security
4. Political economy and governance research
5. Human resources
6. Priority setting principles

Food System in Multiple Systems Context under Stress



Source: Joachim von Braun, Kaosar Afsana, Louise Fresco, Mohamed Hassan and Maximo Torero (2021) Food system concepts and definitions for science and political action. Nature Food. Sept 2021. https://rdcu.be/cxPxJ

Agrifood systems: interacting external and internal elements

Relevant *external* systems

- **Ecology, Water, Climate**
- **Economic & Governance**
- **Health & Sanitation**
- **Science & Innovation**

- **Stressors: climate, conflicts, wars**

Internal food system elements

- **Agriculture, Food Industries**
- **Markets, Services**
- **Income & Employment**
- **Consumption, Nutrition**
- **Science and Innovation**

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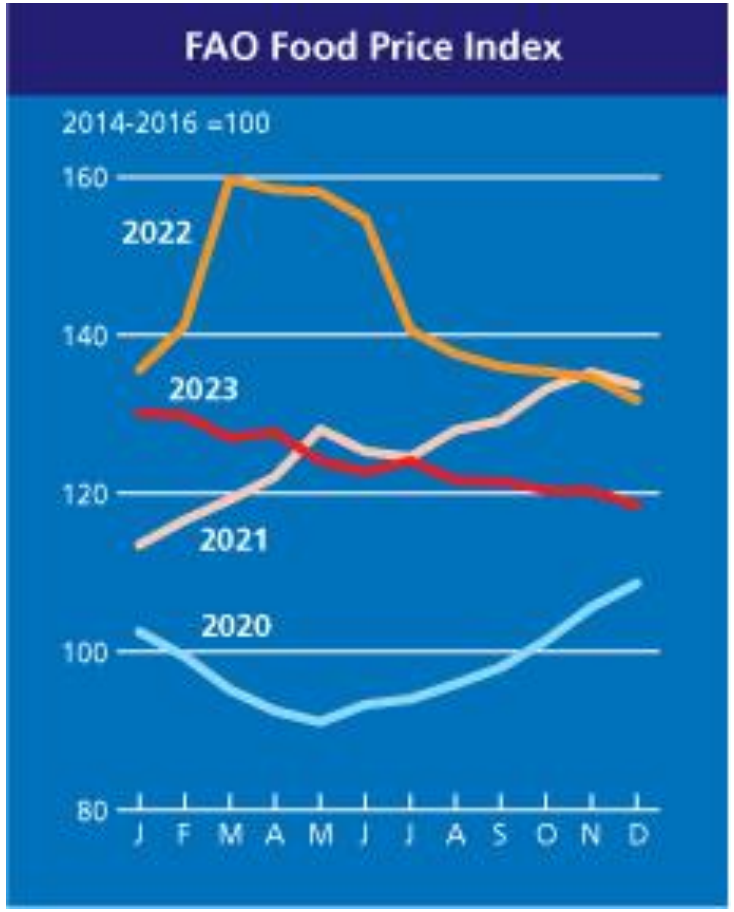
The multi-dimensional food crisis on supply and demand sides and at systems levels

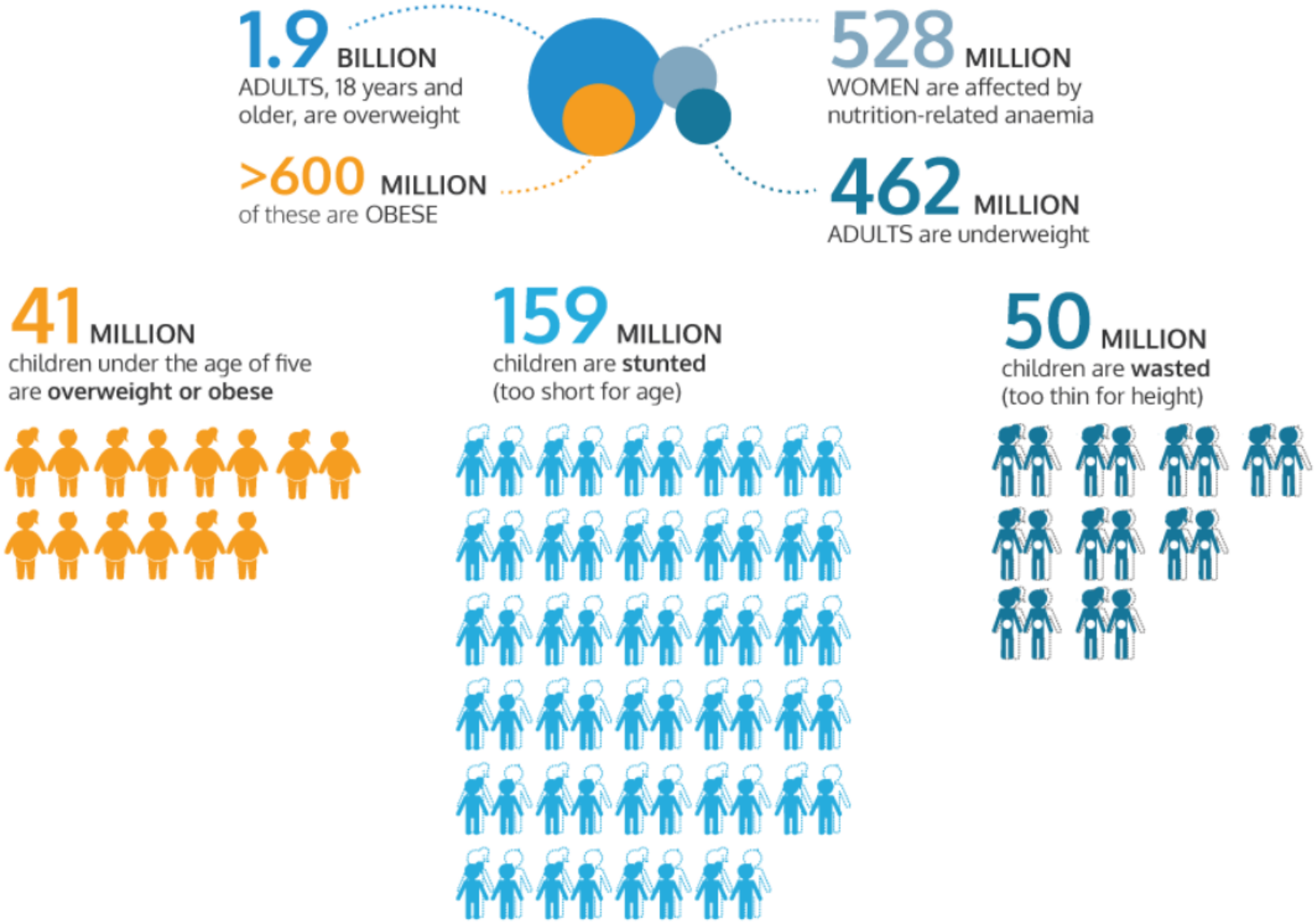
1. **Climate change** destroys food systems resilience
2. **Wars** undermine food systems and hinder trade,
3. **Food price shocks** make healthy diets unaffordable,
4. **Unhealthy diets** contribute to non-com. diseases
5. **Accumulated debts** cut nutrition programs,
6. **Land and soil degradation** undermine sustainability
7. **Food waste and losses** are productivity, climate and moral issues
8. **Erosion of biodiversity & agro-biodiversity** risk food security

T ! (all at different time paths)



https://www.fao.org/worldfoodsituation/foodpricesindex/en/

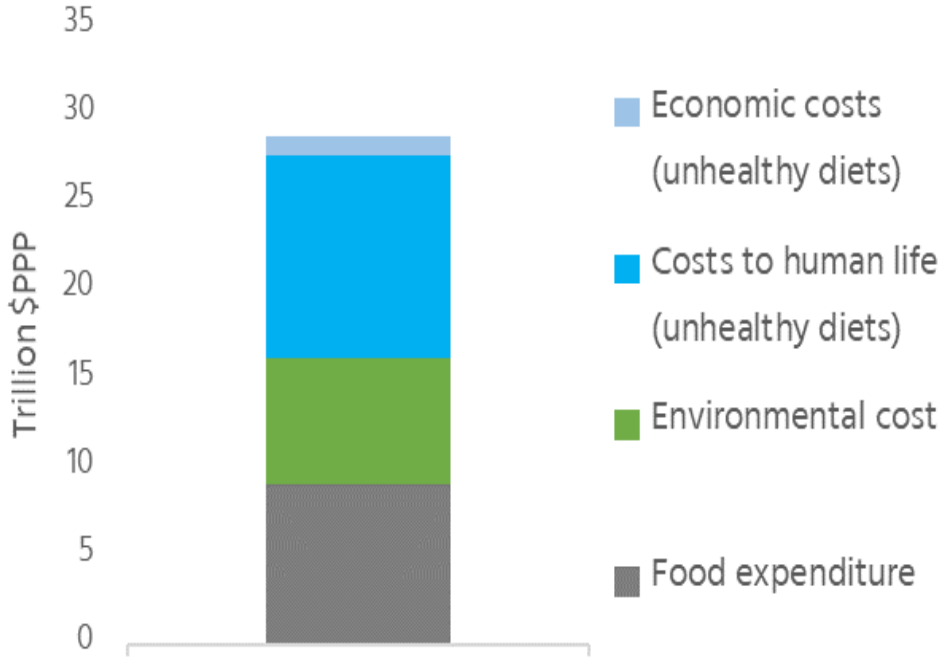
Multiple burdens of nutrition = growing complexity of research needs



WHO Double Burden of Nutrition, 2019. https://www.who.int/multi-media/details/double-burden-of-malnutrition

True Cost of Food

- **Market** prices do not take into account…
  - benefits of affordable or healthy food
  - costs of unhealthy or unsustainable food
- **Business' profits** do not reflect value created/reduced for society
- **GDP** of food system does not reflect contribution to welfare



9 trillion = food in markets
+ 7 trillion = environm. costs
+12 trillion = health costs

ca. = 28 trillion US$

Toward internalization of external costs by price and non-price measures

Source: J. von Braun, S. L.Hendriks (2023) Full-cost accounting and redefining the cost of food: Implications for agricultural economics research. Agricultural Economics. 2023;1–4. https://onlinelibrary.wiley.com/doi/full/10.1111/agec.12774S. And Hendriks et.al. 2023. The True Cost of Food: A Preliminary Assessment. In: von Braun, Afsana, Fresco and Hassan (2023) Science and Innovations for Food Systems Transformation. Springer.

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Strategic balancing acts: connect food system research more with basic science & with indigenous and local knowledge

1. Connect Agrifood systems research to Basic Science

- Artificial Intelligence (AI); remote sensing; robotics; Big data based systems modelling; https://www.pas.va/content/dam/casinapioiv/pas/pdf-volumi/acta/acta27pas.pdf
- novel satellite data and sensor data (e.g. emerging Quantum sensory);
- Complete farm to consumer tracible value chain systems (complex digit.);
- Bioscience innovations (pheno- & genotyping);
- indicator data to assess policy performance (e.g. for carbon farming).

2. Systematic partnership with indigenous and local knowledge communities

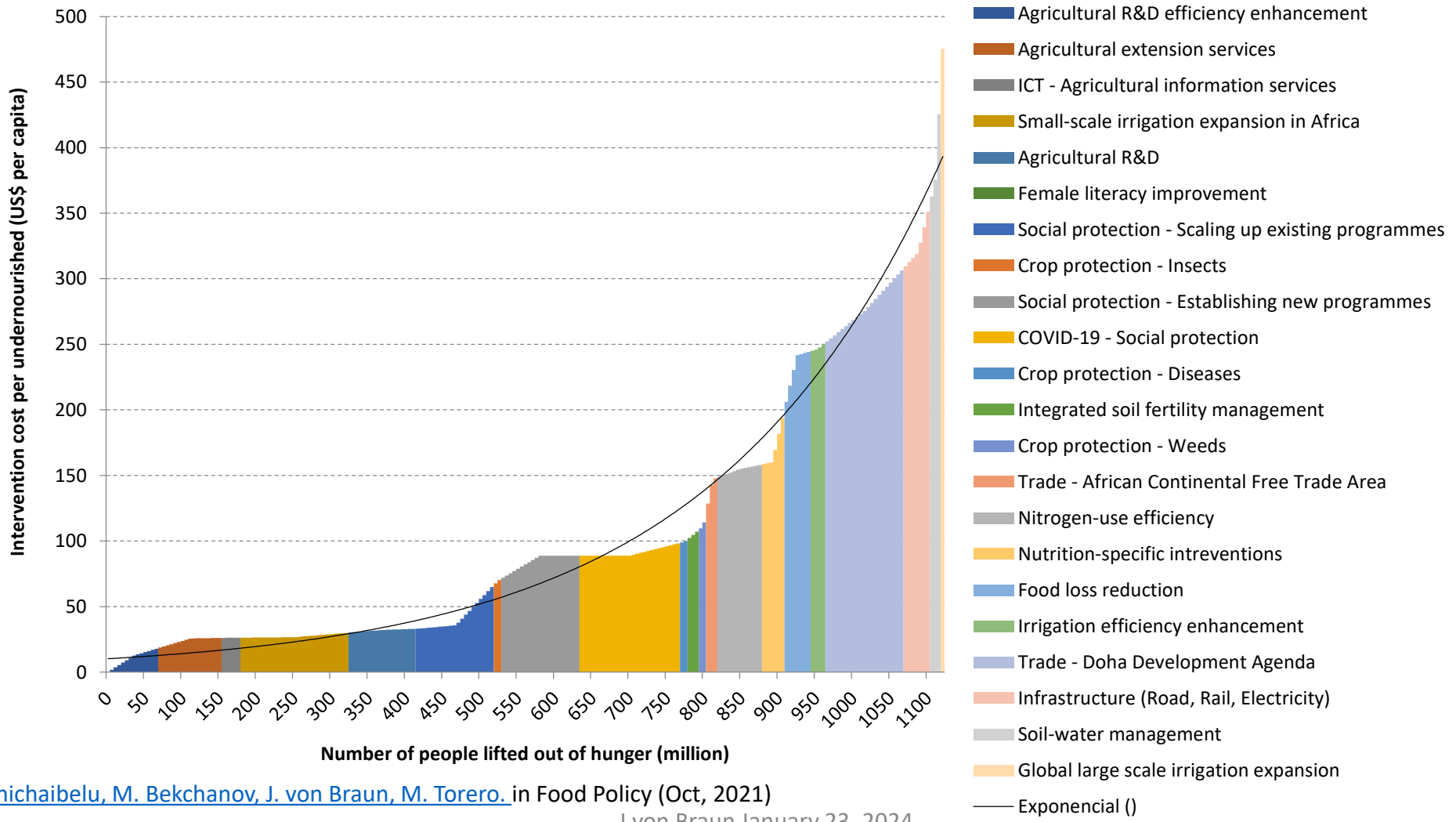
https://www.pas.va/en/events/2024/indigenous_peoples.htm I

The 7 Promising Science and Innovation Areas (UNFSS)

1. **Research for innovations to end hunger:** increase availability, affordability of healthy diets, nutritious foods, women empowerment
2. **Strengthen resilience:** climate-neutral, climate-positive, and climate-resilient food systems
3. Innovations for efficient and fair **land, credit, and labor arrangements**
4. **Bioscience innovations** for peoples' health, system productivity, ecological wellbeing
5. Innovations for productive **soils, land, water, protect the agricultural genetic base and biodiversity**
6. Research for innovations in sustainable **fisheries, aquaculture**, and protection of coastal areas and oceans
7. **Digital innovations** for efficiency and inclusiveness of food systems and rural communities

Source: Scientific Group for the UN Food Systems Summit 2021. And Joachim von Braun, K Afsana, L Fresco and M Hassan. 2021. Food systems: seven priorities to end hunger and protect the planet. *Nature* **597**, 28-30 (2021) https://doi.org/10.1038/d41586-021-02331-x

The bundle of innovations to end hunger and increase availability of and access to healthy diets



Source: [B. Chichaibelu, M. Bekchanov, J. von Braun, M. Torero.](#) in Food Policy (Oct, 2021)

Science for Strengthened Resilience

Mitigation: *Bending the warming curve down*

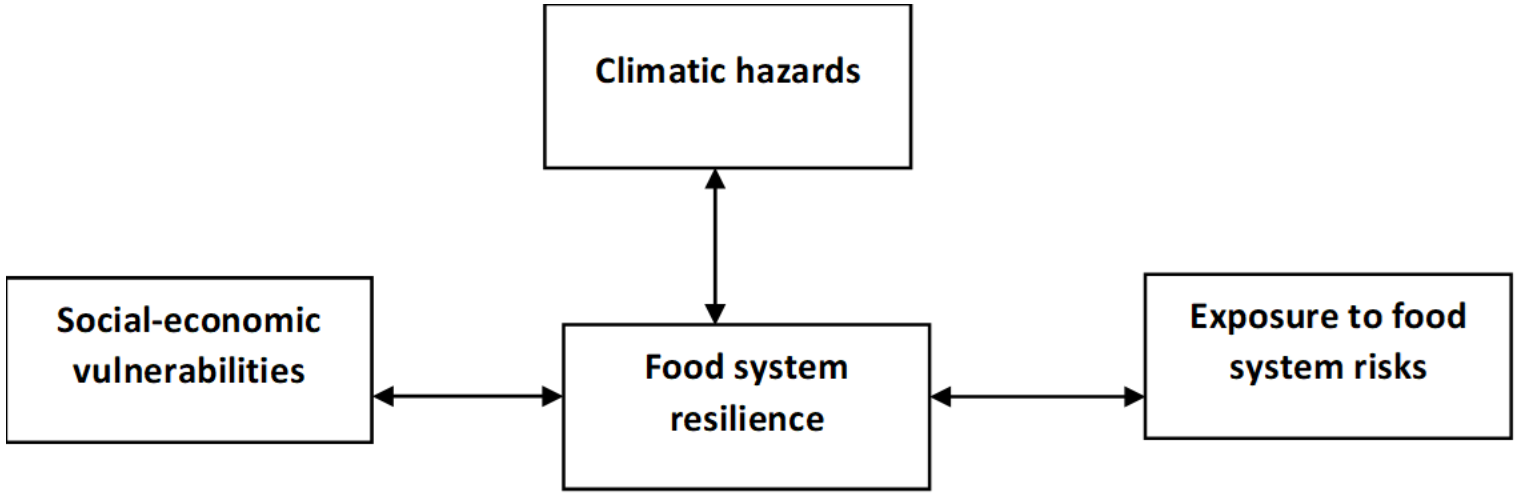
Adaptation: Reductions in risk exposure; & enhancement of adaptive capacity. – Plant innovations; carbon farming; insurance, etc.

Transformation: *Change of lifestyle,* integrate actions on climate, biodiversity, inequality.

Anne Wangalachi CIMMYT
Tanzanian farmer with drought-affected maize

Source: Joachim von Braun, Ramanathan, Turkson. Resilience of people and ecosystems under climate stress (Sep. 2022)

Research Areas for strengthening agrifood system resilience

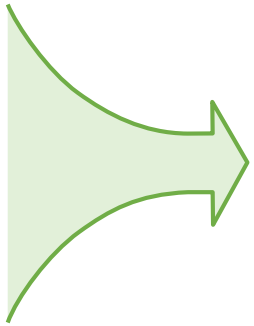


Actions to reduce hazards	Actions to reduce vulnerability	Actions to reduce exposure
• Sustainable soil, land, and water management • Avoiding deforestation • Climate change mitigation	• Social protection; Insurance • Livelihood diversification • Education, agricultural services, • local and indigenous knowledge • Migration options	• Rule based international trade • Infrastructure development • Irrigation expansion • Diversification of production • Conflict prevention & resolution • Sound governance; right to food

Opportunities of research in agroecology

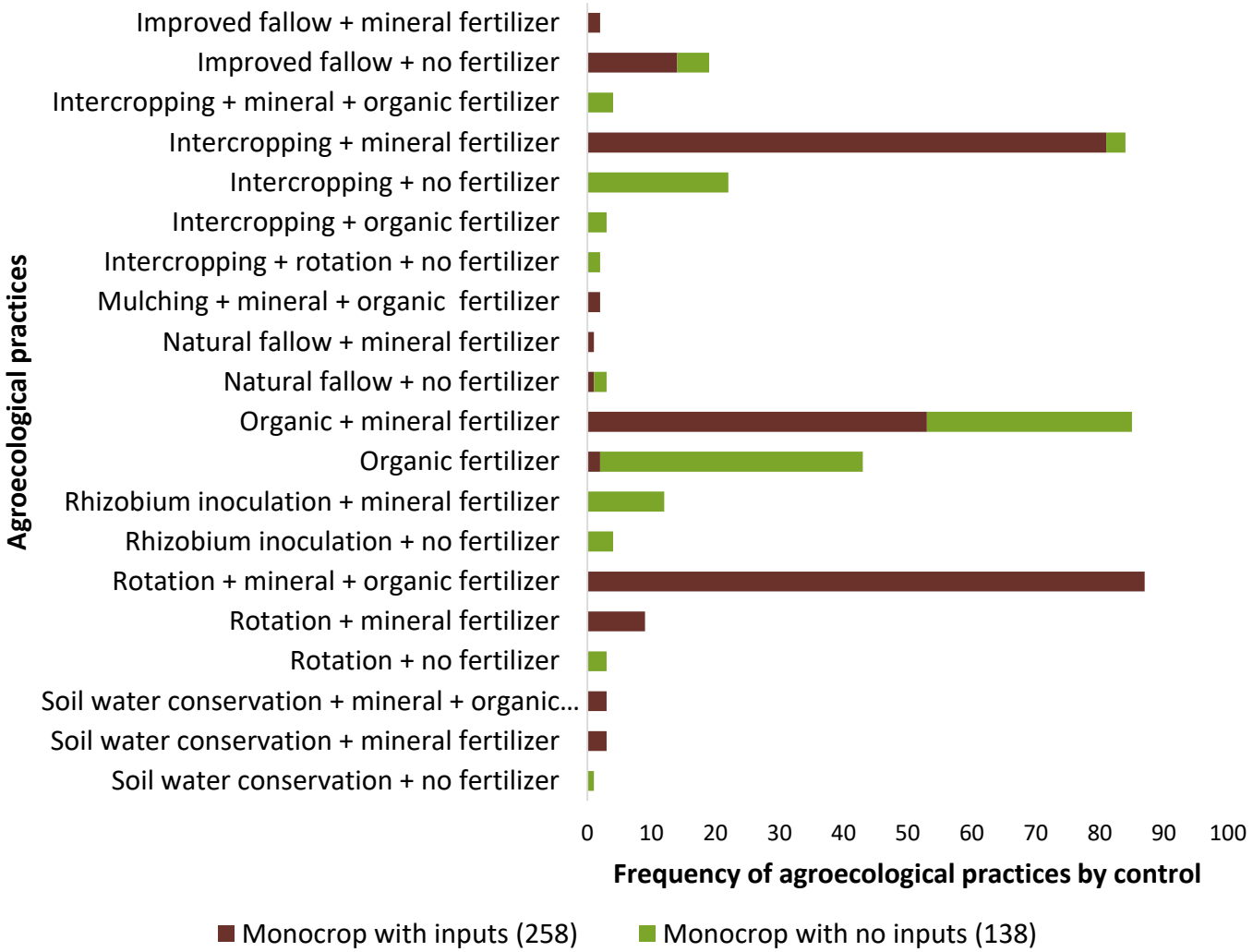
"The premise of this partnership is that we can address these challenges through agroecology, which is an approach, that build on natural, biological interactions while using state-of-the-art science and technology as well as basing innovation on farmers' knowledge and tested best practices." (Draft proposal for a European Partnership under Horizon Europe, 2022)

Impact on
yields?
labour?
markets?
income?



Lack of systematic evidence related to agriculture and food systems, mostly based on single case-studies

Example: research on productivity effects of agroecological practices in Africa



A systematic literature review of empirical evidence shows that:

- Research strongly grew since 2014, but mainly in East Africa
- 501 studies published between 1990 and 2021
- Most of the agroecology-related research does not mention ‘agroecology’ in the title or abstract

Source: Romero, Faye et al. (2024. ZEF, research in progress)

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Political Economy Research on food system governance needed

- **Why need governance?**

Market failures, (global) public goods, scale opportunities, humanitarian principles.

- **What needs governance?**

1 Resources (water, soils) / 2 Climate / 3 trade/ 4 large emergencies / 5 food safety/ 6 research & innovation

- **How and who?** Instruments of gov.; existing agrifood system related organizations of UN, & regional and national level; consider and model alternative gov. options; institutional failure; funding & finance

R&D partnership and governance in agrifood system

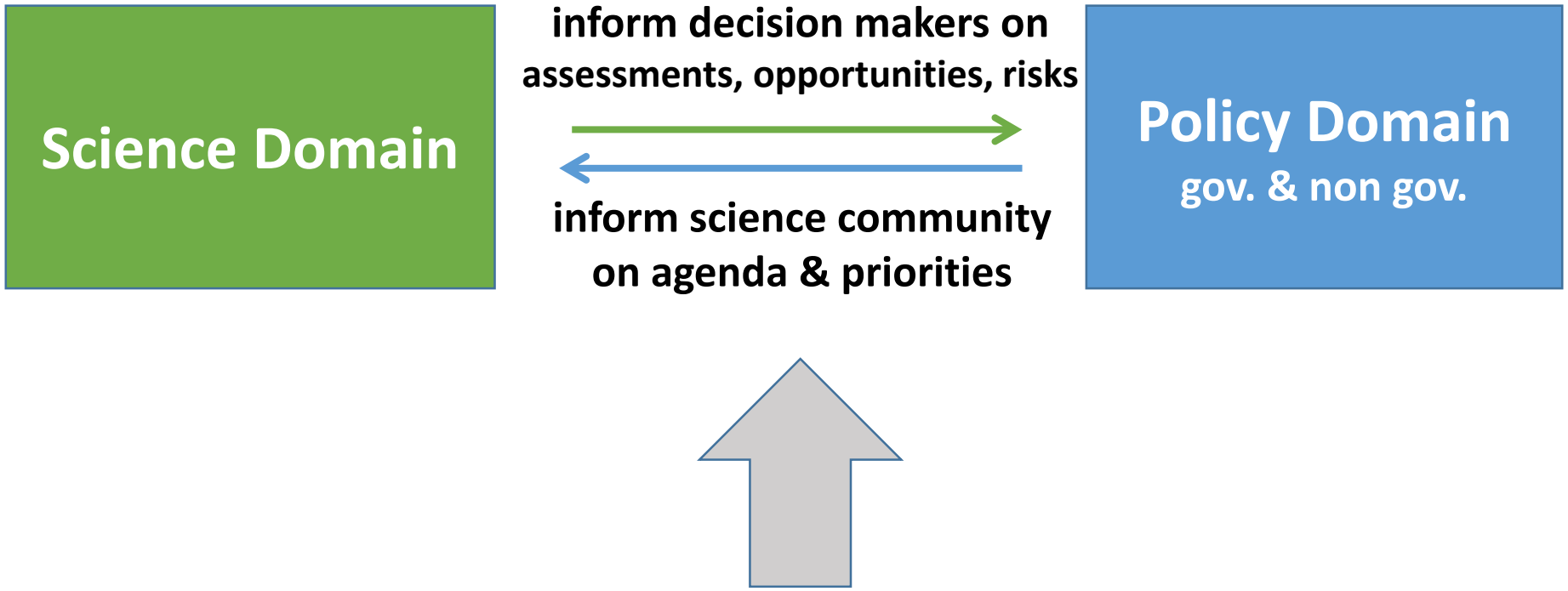
Policy questions:

1. Is R&D mapping of Food Systems at regional and national levels clear?

2. Is all science and knowledge on board? (Public NARS, Universities, Academies, Indigenous and local knowledge, industry based, Start-ups, …)

3. Are the links between local, regional, global established?

Toward structured Science & Policy relations



Political economy research on **coherence of science agendas**

> Global – UNFSS, G20, …

> Africa – Malabo Agenda 2063, etc.

> EU approaches and strategies

EU Partnership ‘Sustainable Food Systems for people, planet and climate’ launched by the Horizon Europe R&I work programme 2023-24. Enabling the European Green Deal (EC, 2021a), the Farm to Fork (EC, 2021b), the Biodiversity (EC, 2022b), Bioeconomy (EC, 2022d) Strategies, Food2030 R&I ambitions towards ‘climate & sustainability’, ‘nutrition & health’, ‘circularity & resource efficiency’, and ‘innovation & communities’.

- USA …
- LAC …

> India …

- China …
- Other …

Science in countries' actual follow up to UN FSS

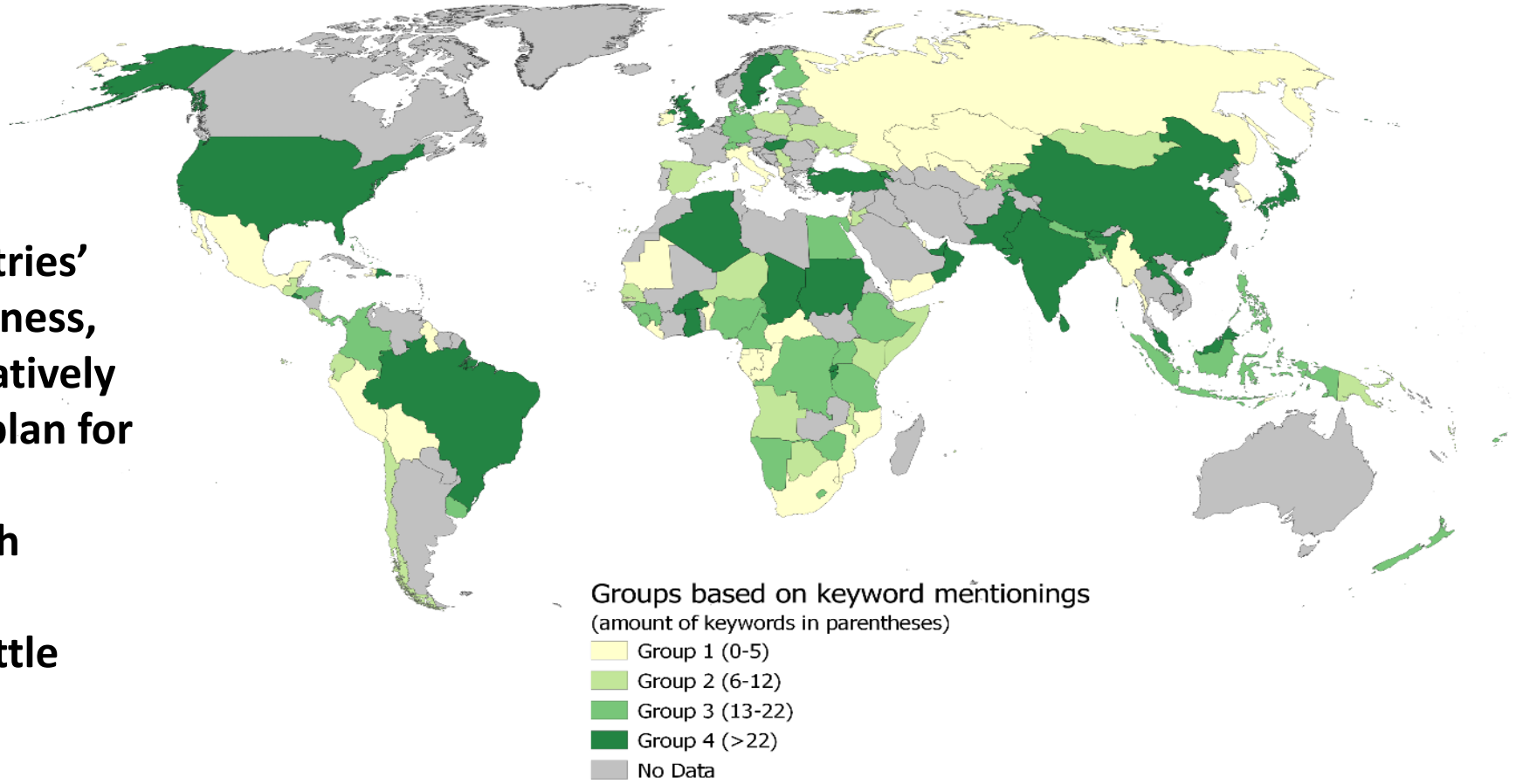
UN-Food Systems Summit 2021 **National Pathways** reports of 118 Countries' attention to science, research, innovation and technology (SRTI)

Analysis finds:

1. Science strongly correlates with countries' governance effectiveness,

2. Countries with relatively larger food systems plan for more Science

3. Countries with high problem of under-nourishment show little Science



Source: von Braun. 2023. UN Food Systems Summit 2021 – What Role Science and Innovation in the Summit and in Countries' Plans and Why?. (ZEF Discussion Paper 325) https://www.zef.de/fileadmin/webfiles/downloads/zef_dp/ZEF_DP_325.pdf

Research on „Transformation of Agrifood to what?“
- toward the Sustainable Bioeconomy

Definition
- Sustainable production and use of biological resources, science, and know how,
- to provide products, processes and services in all economic sectors

- **Science, technologies, social innovations, and demand for sustainability are drivers of the bioeconomy.**
- **Enabling a sustainable, regenerative and circular economy: key for SDG2**
- **The agrifood system is central in bioeconomy;**
- **Connect EU Bioeconomy research with Africa’s, America’s, Asia’s**

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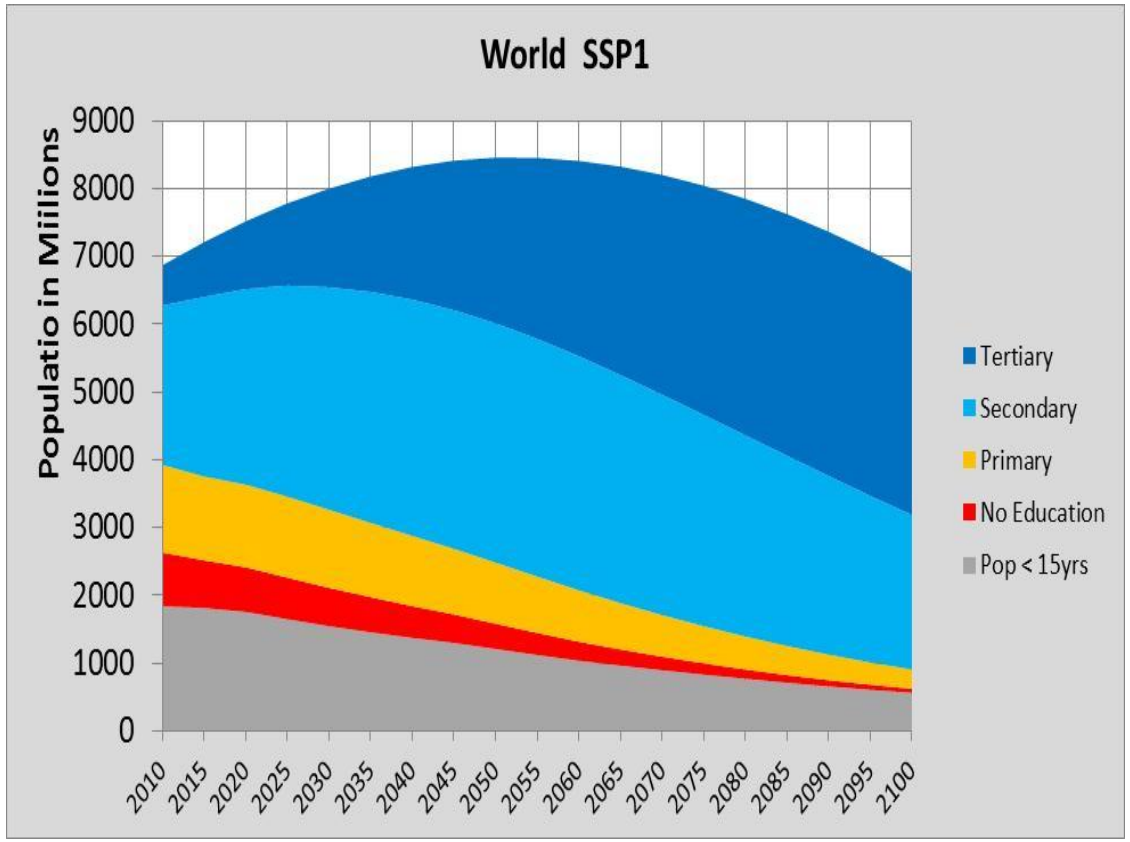
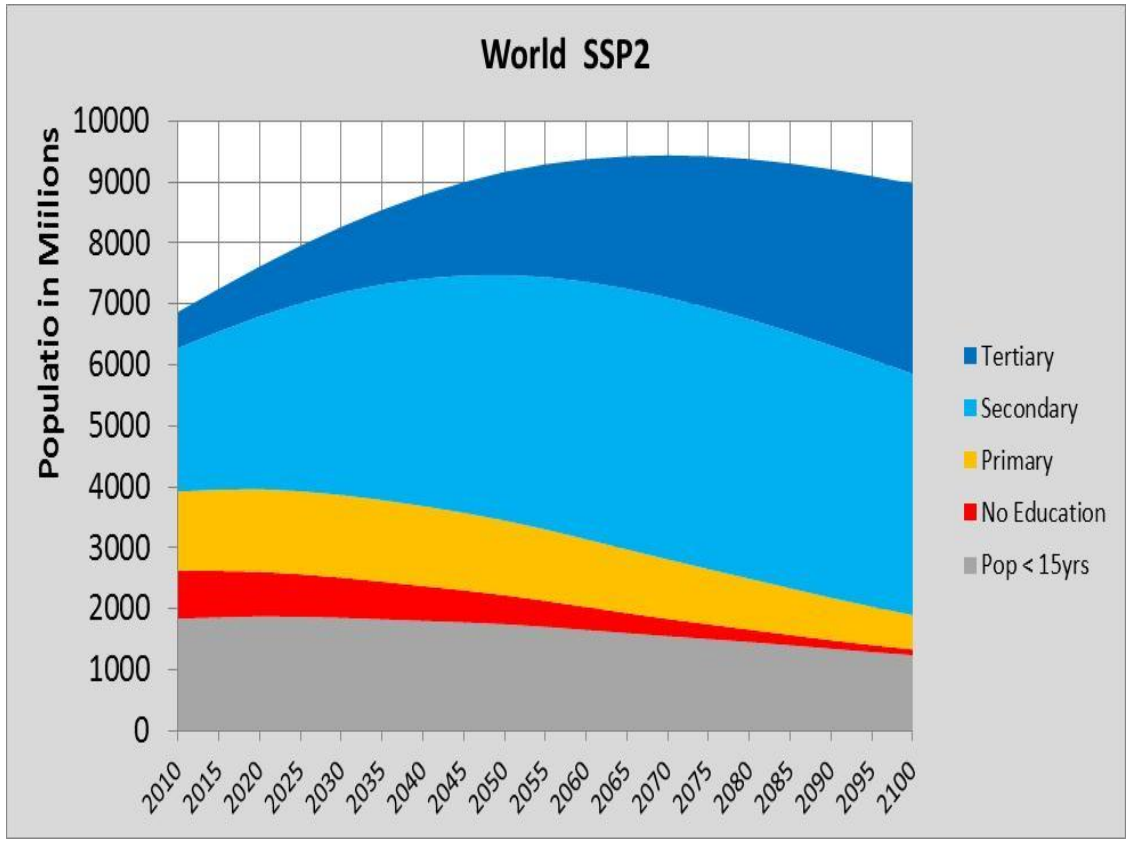
Population and demographics research: bending the population curve to 2100

7 billion **or** **9 billion**

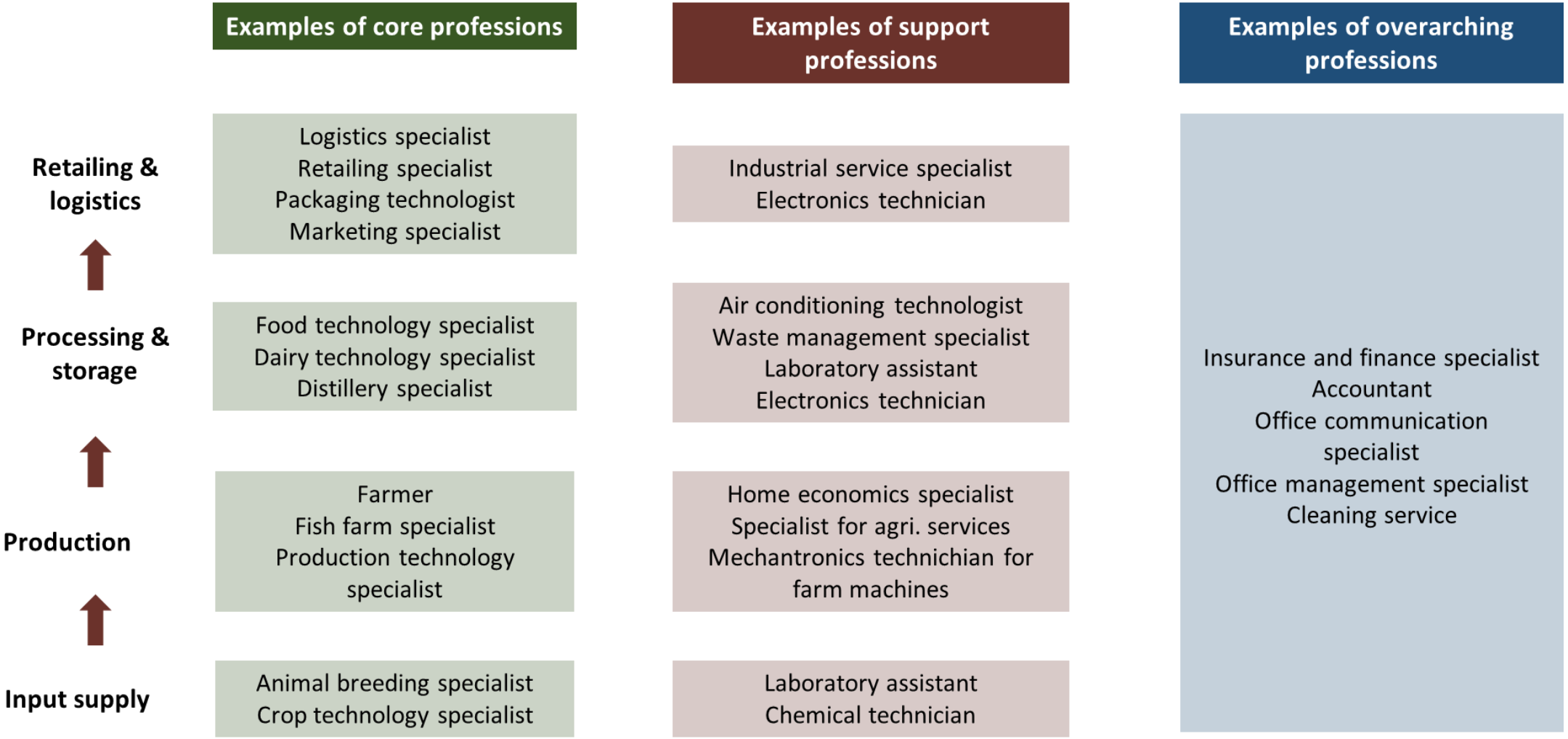




Source: **"World Population Trends and the Rise of homo sapiens literata" Wolfgang Lutz (2020). In:** TRANSFORMATIVE ROLES OF SCIENCE IN SOCIETY: FROM EMERGING BASIC SCIENCE TOWARD SOLUTIONS FOR PEOPLE'S WELLBEING Joachim von Braun Marcelo Sánchez Sorondo (ed.) Pontificiae Academiae Scientiarvm Acta 25 http://www.pas.va/content/accademia/en/publications/acta/acta25.html

Research on demographic transition; education; (pre-) school feeding; gender; …

Research on human resources, labor markets, skills development; next scientists for agrifood system transformation



Source: Kirui in Baumüller et al. (2021)

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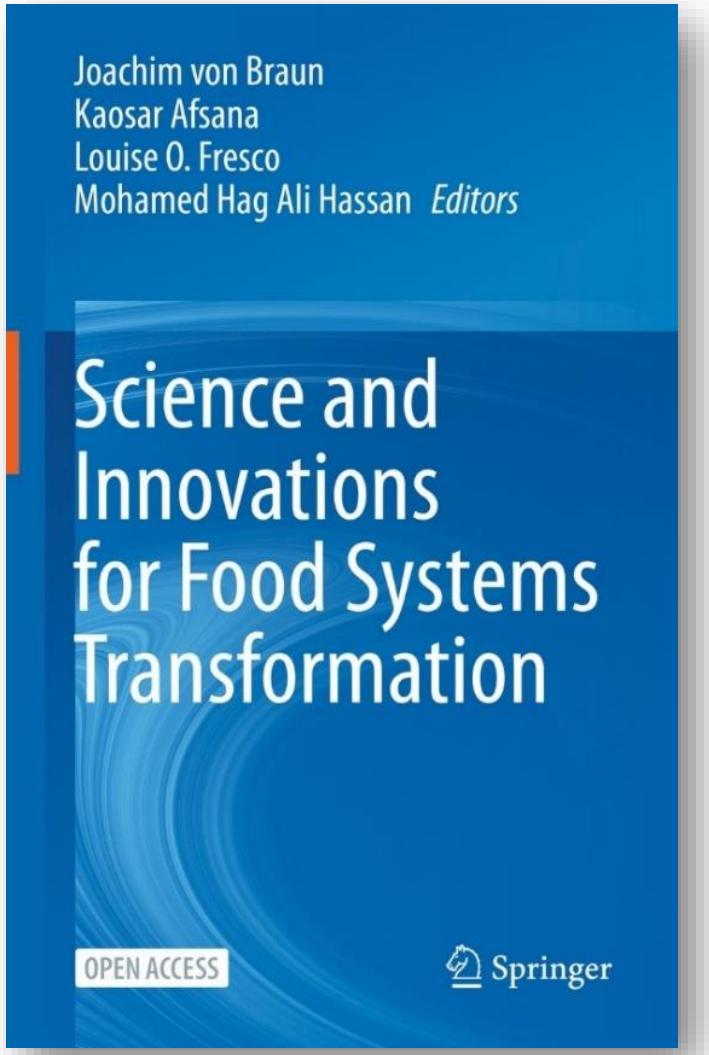
Principles guiding research priorities in agrifood systems
(to be considered in ex ante science impact assessment)

1. **Level of expected short- & long run returns investment, incl. externalities**
2. **Level of expected health and nutrition impacts**
3. **Inclusion of equity, gender, rights**
4. **Inclusion of biodiversity & local, global ecology**
5. **Level of scale in regions & global**

Partnerships of trust and mutual respect



von Braun, J. Afsana, K. Fresco, L., Hassan, M. (Ed.) (2023) *Science and Innovations for Food Systems Transformation.* Open access book. Springer Publ.

Open access: https://link.springer.com/book/10.1007/978-3-031-15703-5