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TempAg: the *International Network for Sustainable Temperate Agriculture*

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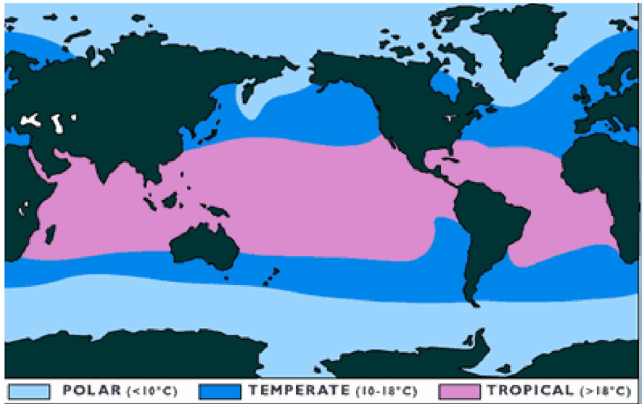
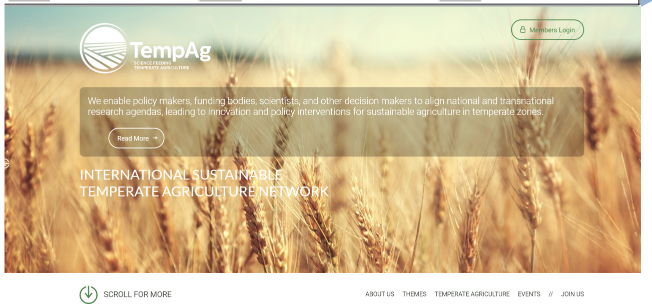
Aim of TempAg

- …to help align and co-ordinate research, synthesise knowledge from, and act as a voice to policy for, *agricultural research in the temperate world* (cf FAO), especially in defining research agenda





TempAg.net

The network currently comprises 12 member countries:

- Belgium
- Finland
- France
- Germany
- UK
- The Netherlands
- New Zealand
- Norway
- Sweden
- Switzerland
- Spain
- South Africa

and OECD as an Associate member.

G2012 MÉXICO

OECD

2012-14 scoping, 2014 launch

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Structure

Governing Board
(Full and Associate Members)

↔

Bureau
(President, Vice-Presidents, Secretariat)

Chaired by
Tim Benton (UK) J-F Soussana (Fr)

Secretariat

Theme 1

Multiple spatio-temporal level

Theme 2

Landscape level

Theme 3

Farm/enterprise level

Theme 4: from agriculture to food systems (FLW)

Theme 5: research needs for the future of food

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2015-17 activities

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Unified framework for assessing sustainability, focussing at country level

Theme 1 - Pilot Activity

Conceptual frameworks for defining agricultural sustainability at multiple levels, led by New Zealand

Theme Lead: Richard McDowell

Summary

To investigate whether sustainability frameworks, metrics, tools and their implementation can be enhanced to future-proof agricultural decision making at multiple levels and scales.

Theme 2 - Pilot Activity

Optimising synergies between agricultural production and ecosystem services, led by Sweden & France

Theme Lead: Janne Bengtsson

Summary

To design land use systems that optimise synergies between agricultural production and ecosystem services (ES). The activity initially focuses on understanding the research landscape on ecosystem services in temperate agriculture.

Theme 3 - Pilot Activity

Yield gaps and resource use efficiency, led by the Netherlands

Theme Lead: Martin van Ittersum

Summary

To examine how to sustainably improve food productivity at a farm/enterprise level, through addressing yield gaps, resource use efficiencies and environmental impact. This research will attempt to answer the question:

"Is it possible to define 'sustainable' yield levels, with an acceptable compromise between production, resource use efficiency and environmental impact?"

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Theme 4: Waste research and innovation priorities

	Challenges	Context and future priorities
Farm production - agri & aqua-culture & livestock	Product standards and uniformity including food safety Pest and disease pressure, extreme weather conditions Sustainable ecosystem services – mitigate environment impacts by lower inputs Sustainable crop production – Higher crop productivity and greater resource efficiency Sustainable livestock – Higher animal welfare & productivity. Potential GHG mitigation and impact of diversion from food crop yields. Environmental impact of restricting feeding food waste to animals. Sustainable aquaculture welfare/productivity Farm machinery efficiencies - reduce losses in handling, transportation and storage. Forecasting – meeting retail demands Frequency of food spikes.	**Agricultural losses** are largely derived from product specifications (e.g. out-gradings) and contractual agreements excesses. Seed and crop development research along with agronomy and agricultural engineering advances (e.g. precision farming) are anticipated to provide more uniform produce and greater harvesting efficiencies. In parallel, adoption of a food systems approach enables waste reductions to be researched within context of sustaining ecosystems. **Future priorities:** + Agile automated harvesting technologies + Good seasonal weather prediction to allow "adaptive" planing and management + Economic forecasting to alleviate social costs of low availability - high demand ('food spikes') + Novel control of pests, disease and weeds + Research into changing consumer perceptions and acceptance of food + Plant breeding programmes to focus on nutrient uptake and energy use (e.g. CO_2, NOx) + Alternative approaches to pesticide and herbicide regimes + Animal or fish breeding programmes to enhance productivity & welfare + Animal feedstuffs and methane emissions + Engineering energy consumption and emissions.
Storage	Post-gate spoilage/shelf-life extension – reduce waste through handling, transportation & storage. Additional benefits derived from seed/crop enhancement Microbial spoilage of produce - better understanding of food spoilage processes Cold-chain faster, development of deep chill technologies, efficient preservation processes, temperature stability, reduce energy inputs, emissions & hardware failure Monitoring product integrity, need accurate, faster detection and greater containment of spoilage or microbial contamination	**Post-farm gate storage** losses primarily occur through produce handling and limitations in storage capabilities. Storage is crucial as a stage-gate between supply and demand. The supply-chain could become exposed to greater waste if temperature-time indicators were introduced; therefore technology adoption and transfer are crucial. A key priority is to minimise temperature fluctuations throughout supply-chains. The long-term need is to gain a fuller understanding of plant maturation and ripening pathways, ultimately to extend storage life, taste and shelf-life. Novel sensors (e.g. photo-electronics or biosensors) provide future opportunities for real-time monitoring to enable immediate intervention in rescuing potentially wasted produce. **Future priorities:** + Plant research into biological pathways of maturation and ripening + Microbial research into modes of action and interactions with food + Investigation into the potential of existing technologies (e.g. ethylene management, modified atmosphere packaging) or emerging technologies (e.g. nano-technology) to help manage ethylene and microbial spoilage. + Engineering cold-chain - temperature fluctuation and stabilisation + Novel sensors to monitor product integrity and microbial containment + Advanced cold-chain - Novel refrigerants (non-GHG).

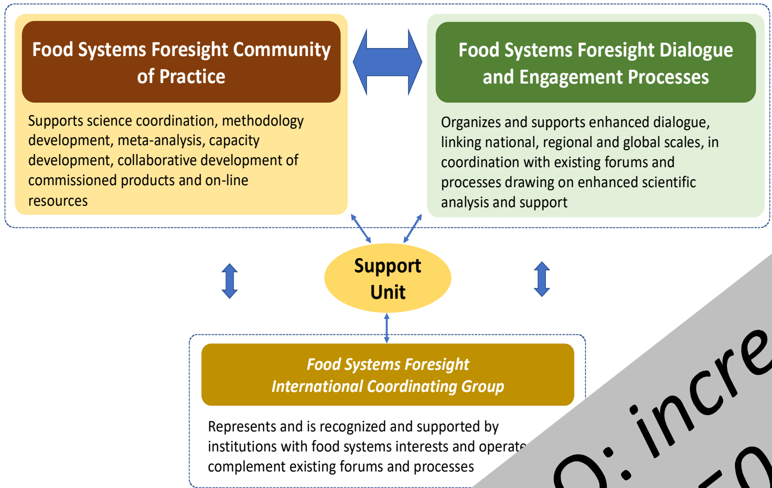
	Challenges	Context and future priorities
Processing	Technology adoption & transfer - Low levels of automation, robotics or flexible processing systems Food preservation – microbial management of food products and clean-air environments Resource efficiency – reduce wastewater & energy inputs Monitoring – reducing process inefficiencies, and increasing QC measures for processed foods & drinks Supply-chain models – meeting consumer affordability, demands and values	**Processing** in the food sector comprises a few Multi-national corporations (MNCs), but is dominated by thousands of Small and medium enterprises (SMEs). This stage of food manufacturing provides the greatest scope for re-engineering to meet the demands of multiple short-runs and frequent switchovers. Whilst many business solutions may be addressed by existing technology adoption or transfer, there is potential to push the early adopters towards more advanced automation and robotics to extend boundaries of competitive advantage. Throughout this business chain, there is also a recognised priority need to reduce water utilisation, especially through advanced engineering of processes and development of alternative solutions. **Future priorities:** + Process innovation through existing technology transfer and adoption + Process innovation through novel engineering process run efficiencies: • 'Agile' automation and robotics • Flexible, modular systems for product changeovers + Economic analysis of supply-chains and alternative business models + Reduced water utilisation - novel hygiene/decontamination processes + Novel sensors to monitor Quality Control processes Low impact heating & cooling technologies + Optimising resource efficiency (e.g. energy, water etc.), which is linked to developing processing, engineering and automation technologies.
Packaging	Shelf-life extension – minimise microbial contamination/product spoilage; extending product life within retail and consumer premises (households/food-service sector) Information and tracking systems – direct microbial control of products and indirectly through innovative packaging Consumer acceptance –new packaging and labelling technologies, and extended shelf-lives	**Packaging** technologies have provided significant advances in minimising spoilage and microbial contamination, thereby extending shelf-life and reducing waste concurrently. There still exists significant potential in utilising new materials and processes to further extend product integrity, and in providing supplementary retailer and consumer information. The popularity/need of product traceability and authenticity is likely to expand in the future. **Future priorities:** + Extension of active packaging technologies and applications + Extension of intelligent packaging technologies and applications + Consumer awareness of packaging benefits within the home + Extension in clean-room environments (anti-bacterial surfaces) and anti-microbial applications.
Retail	The 'final 50 yards': Forecasting & inventory management to minimise surplus whilst maximising shelf replenishment and in-store shelf-life times Cold-chain (as above for 'Storage') Consumer choice: Provision of high value, quality & safe food. Purchasing needs versus wants (promotions) Date labelling – consumer confusion and potential to extend maximum product life?	**Retail** environments are highly complex and dynamic, commanding established IT-systems capabilities to co-ordinate the flow of goods through stage-gate processes of the supply-chain. Retailers also serve as a technological hub throughout the supply-chain including innovations in packaging and data-labelling. However, dense environments and fast-flow of goods in backroom retail warehousing remains highly challenging. There is a priority need to understand consumer choice: using alternative providers (e.g. local markets or boxed vegetable deliveries) or food ethics (e.g. food miles or in-season) to consider the social impacts of future food provision models. **Future priorities:** + Advanced integrated supply-chain tracking systems + Flexible warehousing processes + Consumer engagement in food management skills + Retailer – consumer relationship - Corporate social responsibility + Adoption of refillables and re-usables + Optimising resource efficiency (e.g. washing vegetables before sale).

https://www.foodsecurity.ac.uk/publications/food-waste-within-global-food-systems.pdf

Theme 5: Foresighting and scenarios when the future is uncertain

- Populat… …th
- Eco… …and inequalities
- …ruption
- … diets and … forms"
- …gradation
- …r land, water
- …ionalism
- …around the globalisation …nda and international rules-based cooperation

FAO: increase food by 60% by 2050 is a scenario, based on a set of assumptions, characterised by "recent trends predict the future"



International Collaborative In…

on

Enhancing Foresight and Scenario Analysis for Glo…

Foresight4Food

ACIAR, AgMip, Agrimonde & Agrimonde-Terra , A… National University, BANAHPROVI, Honduras, CAAD… CCAFS, CIRAD, CORAF, DFID, Oxford University, Europ… Union, FAO, CGIAR (including ISPC and IFPRI), FARA, Ga… Foundation, University of Queensland, GFAR, ICASEPS, IDR… IIASA/GLOBIOM , IISD, INRA, NEPAD, OXFAM, Oxford Martin School, RUFORUM, The Syngenta Foundation, University of Leeds, USAID, Wageningen University and Research, WBCSD, World Bank https://www.weforum.org/whitepapers/shaping-the-future-of-global-food-systems-a-scenarios-analysis

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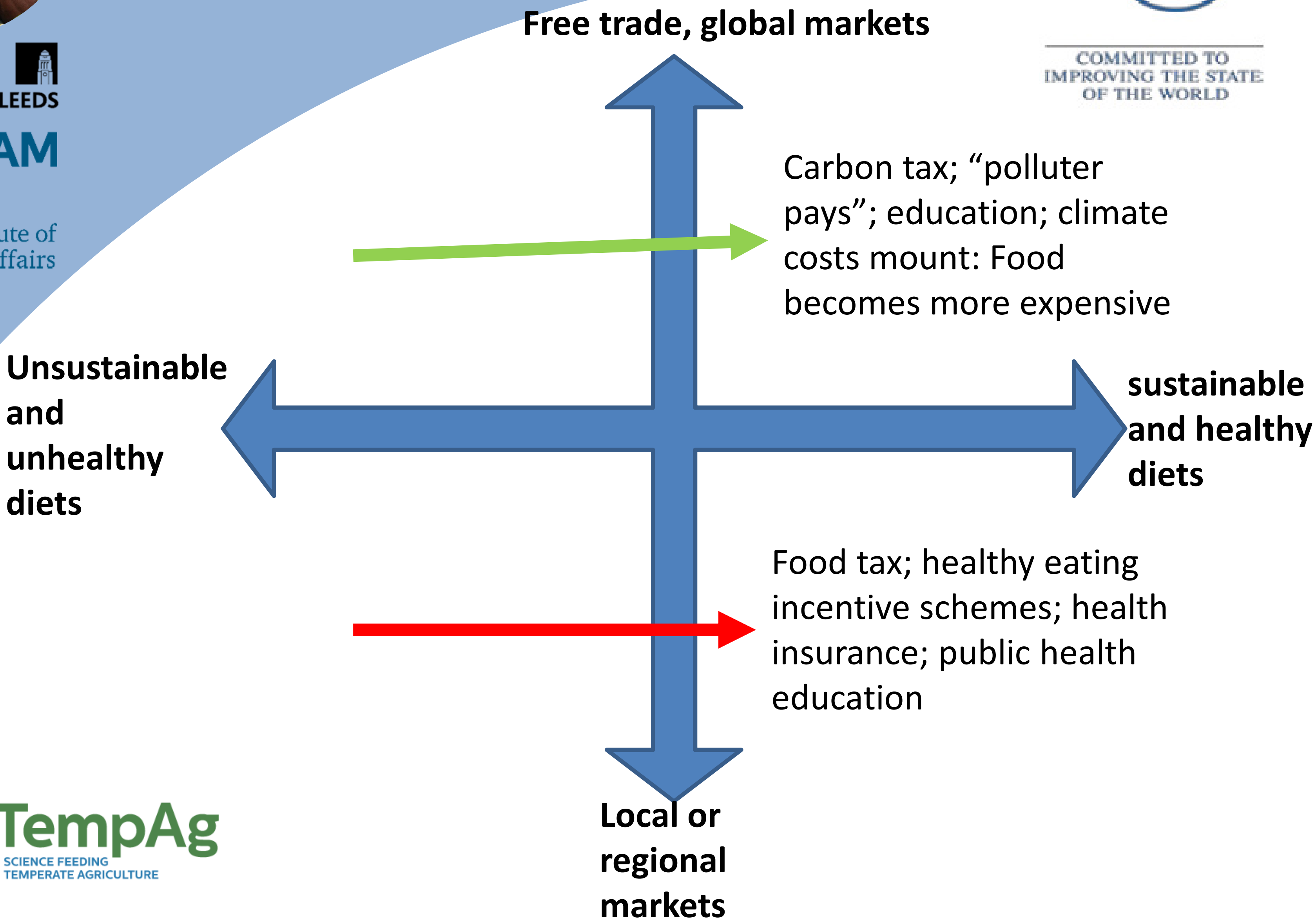
Alternative futures

WORLD ECONOMIC FORUM
COMMITTED TO IMPROVING THE STATE OF THE WORLD



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Future food

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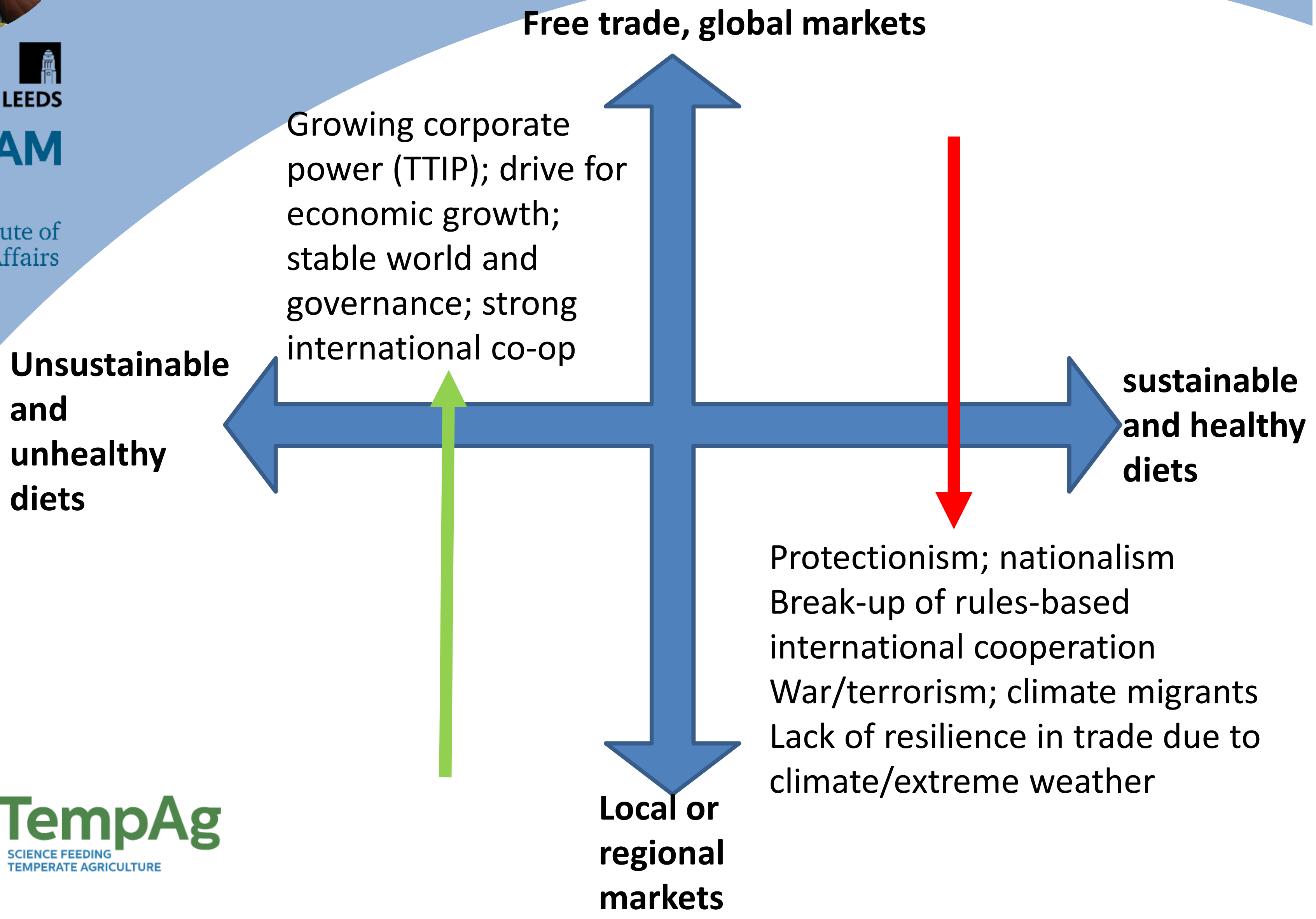

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Futures of food

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Free trade, global markets

Unchecked consumption

- *Growing ill-health*
- *More climate change*
- *More natural resources required*
- *MNC interests dominate politics*

Sustainable, high-tech world

- *Global innovations and tech platforms*
- *High efficiency*
- *App-driven personalised nutritious diets*
- *Consumers buy attributes*

Unsustainabl and unhealthy diets

sustainable and healthy diets

Money talks most

- *Disconnected world with weak economic growth*
- *"post war economy"*
- *Unsustainable production to meet demands locally*
- *"spatial inequality"*

Local is lovely

- *Sustainable nutrition drives local industry*
- *"local food" SMES and artisanal food valued*
- *Holistic economies – low waste, high health and well being*
- *"spatial inequality"*

Local or regional markets

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What role for technology?

ee trade, global markets

Sustainable, high-tech world
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sustainable and healthy diets

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Local or regional markets

Commodity crops, large scale
Biotechnology and biofortification
Ultra-processed foods
Long supply chains
Lots of robotics

More varied diets to provide nutrients
More varied farming systems, smaller scale
Less agricultural efficiency and more system efficiency
Low waste
Whole foods, cooked at home
Short supply chains

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TempAg role in Foresight

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- To help take foresight work and understand its assumptions, framing and limits
- Translate scenarios of what the world might look like into potential knowledge gaps and research agenda
- Downscale global research gaps to member country needs
- Make others’ foresight exercises policy-useful for different countries

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Conclusions

- TempAg aims to work across the temperate world to help countries discuss and align around shared research agenda, connecting research to policy communities
- Current foci of work on "sustainable intensification and metrics", food loss and waste, and research agenda under different potential futures

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Thank you!

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