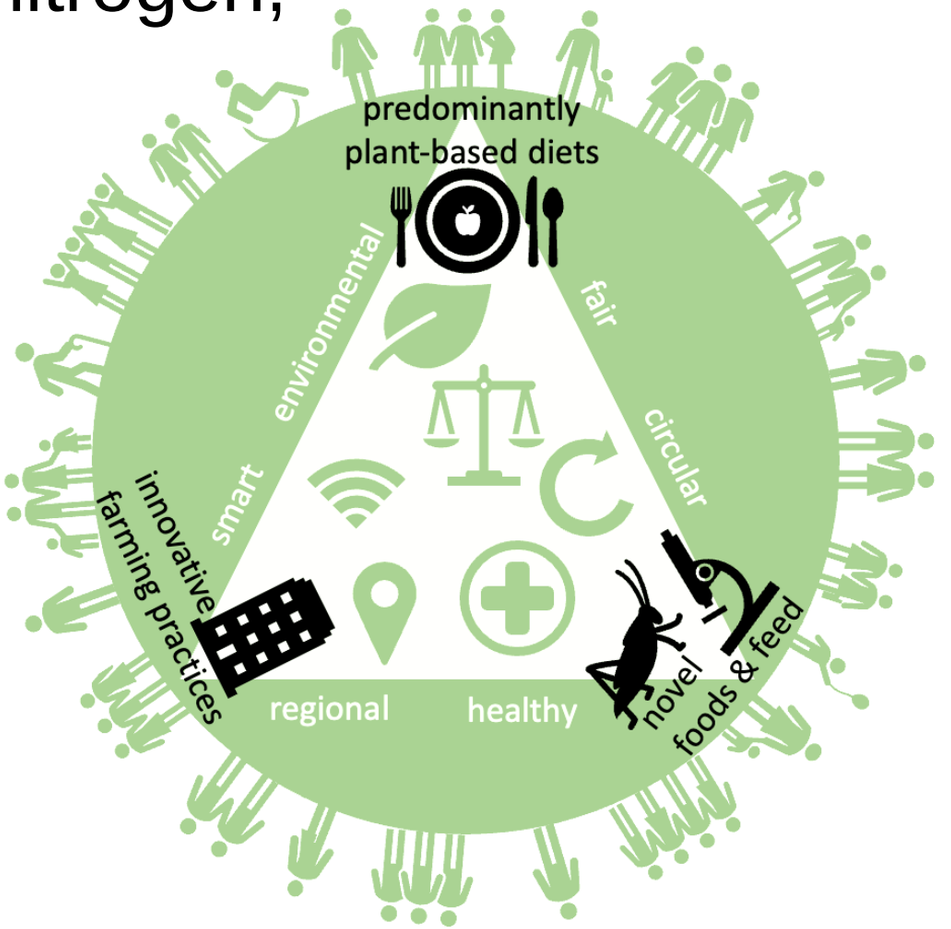
Appetite for Change

Food system options for nitrogen, environment & health



[Appetite for Change: Food system options for nitrogen, environment & health. 2nd European Nitrogen Assessment Special Report on Nitrogen & Food (zenodo.org)]

European Nitrogen Assessment
2nd Special Report on Nitrogen & Food

***Adrian Leip**, European Commission - TFIAM 53, 16/04/2024*
Susanna Kugelberg, WHO – now Copenhagen Business School

Why care about nitrogen pollution?

World
Over $400 billion
of N wasted

A high-level goal as a focus for action

UN Day
24 Oct 2019

UN Day, Oct 24 2019: Colombo Declaration

Launches the UN Campaign on Sustainable Nitrogen Management. 14 Countries agree the ambition to

halve nitrogen waste by 2030

May
2020

EU Farm to Fork Strategy & EU Biodiversity Strategy

Embraces the ambition to

reduce nutrient pollution by 50% by 2030

March
2022

UN Environment Assessmbly Resolution 5/2

Encourages Member States to accelerate actions to

significantly reduce nitrogen waste globally by 2030 & beyond

Dec
2022

UN Kunming-Montreal Global Biodiversity Framework

Countries agree Target 7 including: *by 2030…*

reducing excess nutrients lost to the environment by at least half

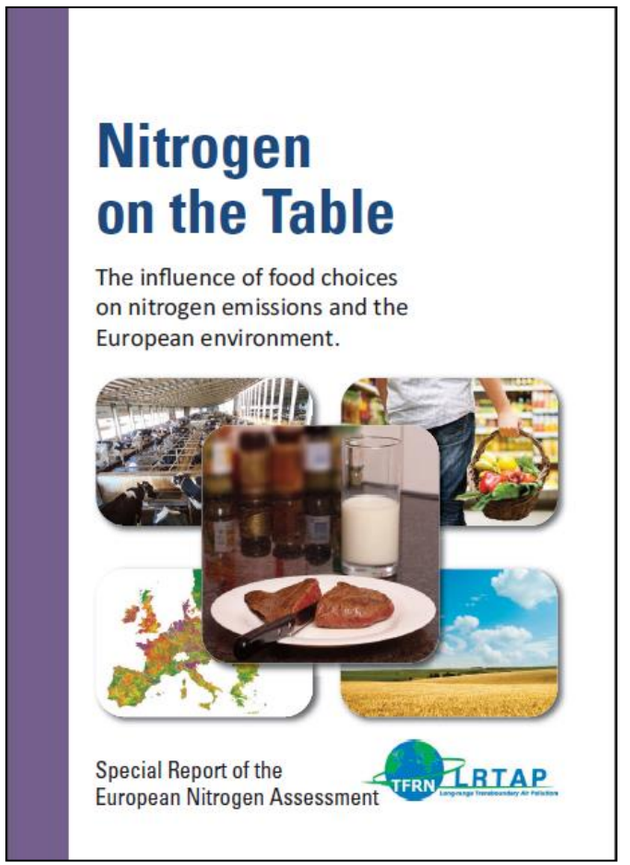
INMS

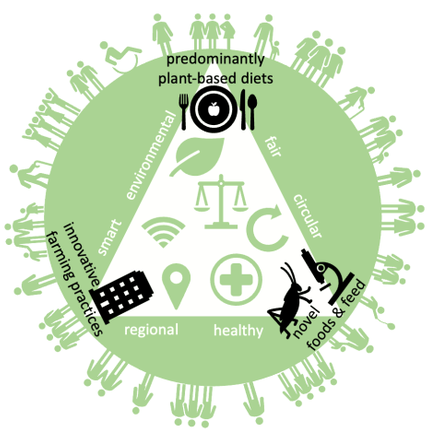
International Nitrogen Management System

What next after the European Nitrogen Assessment? (2011)

1st Special Report on Nitrogen & Food (2014/2015)

- The food system (esp. livestock) accounts for 80% of European nitrogen emissions
- **Nitrogen losses per unit of food protein from beef are >25 times those from cereals. For pig and poultry meat, eggs & dairy, the losses are 3.5 - 8 times those from cereals**
- Per capita protein consumption greatly exceeds recommendations of the World Health Organization
- **Halving meat and dairy intake would reduce agricultural nitrogen pollution by 25-40%, allow expansion of bioenergy crops, and reduce imports of soybeans by 75%.**





2nd Special Report on Nitrogen & Food (2023)

What are the options available to reduce pollution from our food?
How can society be mobilized to make the necessary changes?

The EPNF2 process towards Appetite for Change

CLRTAP - TFRN - Expert Panel on Nitrogen and Food

GFS Special Issue - "Managing nutrients: the key to achieve sustainable food systems for healthy diets" in the journal Global Food Security.

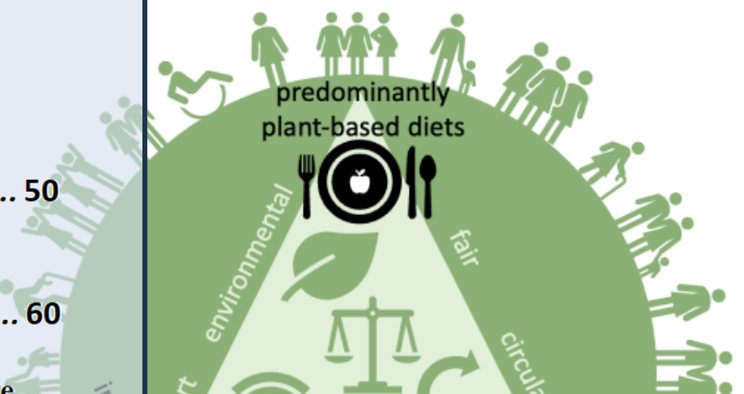
1. Corrado, S. et al. 2020. **Unveiling the potential for an efficient use of nitrogen along the food supply and consumption chain**
2. Costa Leite et al. 2020. **Healthy low nitrogen footprint diets**.
3. Hebinck, A. et al. 2021. **A Sustainability Compass for policy navigation to sustainable food systems.**
4. Hutchings, N.J. et al. 2020. **Measures to increase the nitrogen use efficiency of European agricultural production**.
5. Kugelberg, S. et al. 2021. **Implications of a food system approach for policy agenda-setting design**.
6. Latka, C., et al. 2021. **Paying the price for environmentally sustainable and healthy EU diets**.
7. Leip, A. et al. 2021.**The role of nitrogen in achieving sustainable food systems for healthy diets**.
8. Puigdueta, I. et al. 2021. **Urban agriculture may change food consumption towards low carbon diets**.
9. Weindl, I. et al. 2020. **Sustainable food protein supply reconciling human and ecosystem health: A Leibniz Position**.

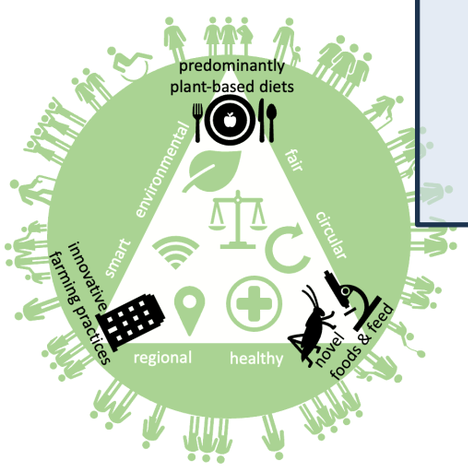
Other publications

- Parodi, A. et al. 2018. **The potential of future foods for sustainable and healthy diets**. Nat. Sustain.
- Leip, A. et al. 2019. **The value of manure - manure as co-product in life cycle assessment**. J. Environ. Manage.
- Leip, A. et al. 2019. **Nitrogen Footprints**. Encycl. Ecol.
- Vanham, D., et al. 2019. **Environmental footprint family to address local to planetary sustainability and deliver on the SDGs**. Sci. Total Environ.
- Sanz-Cobena, A. et al. 2020. **Research meetings must be more sustainable**. Nat. Food
- Temme, E.H.M. et al. 2020. **Demand-Side Food Policies for Public and Planetary Health**. Sustainability
- Vanham, D., Leip, A., 2020. **Sustainable food system policies need to address environmental pressures and impacts: The ex. of water use and water stress**. STE
- Kanter, D.R. et al. 2020. **Nitrogen pollution policy beyond the farm**. Nat. Food 1, 27–32.
- Kobayashi, Y. et al. 2022. **Vertical farming: A trade-off between land area need for crops and for renewable energy production**, JCleaner Production
- Latka, C. et al. 2022. **Competing for food waste – Policies' market feedbacks imply sustainability tradeoffs**. Resources, Conservation and Recycling
- Leip, A. et al. 2022. **Halving nitrogen waste in the European Union food systems requires both dietary shifts and farm level actions**, Global Food Security.
- Springmann, M. et al., 2023. **The global and regional air quality impacts of dietary change**. Nature Communications
- **CERCEDILLA MANIFESTO: Research meetings must be more sustainable** - Sign the openpetition.eu/!cercedillamanifesto

Appetite for Change

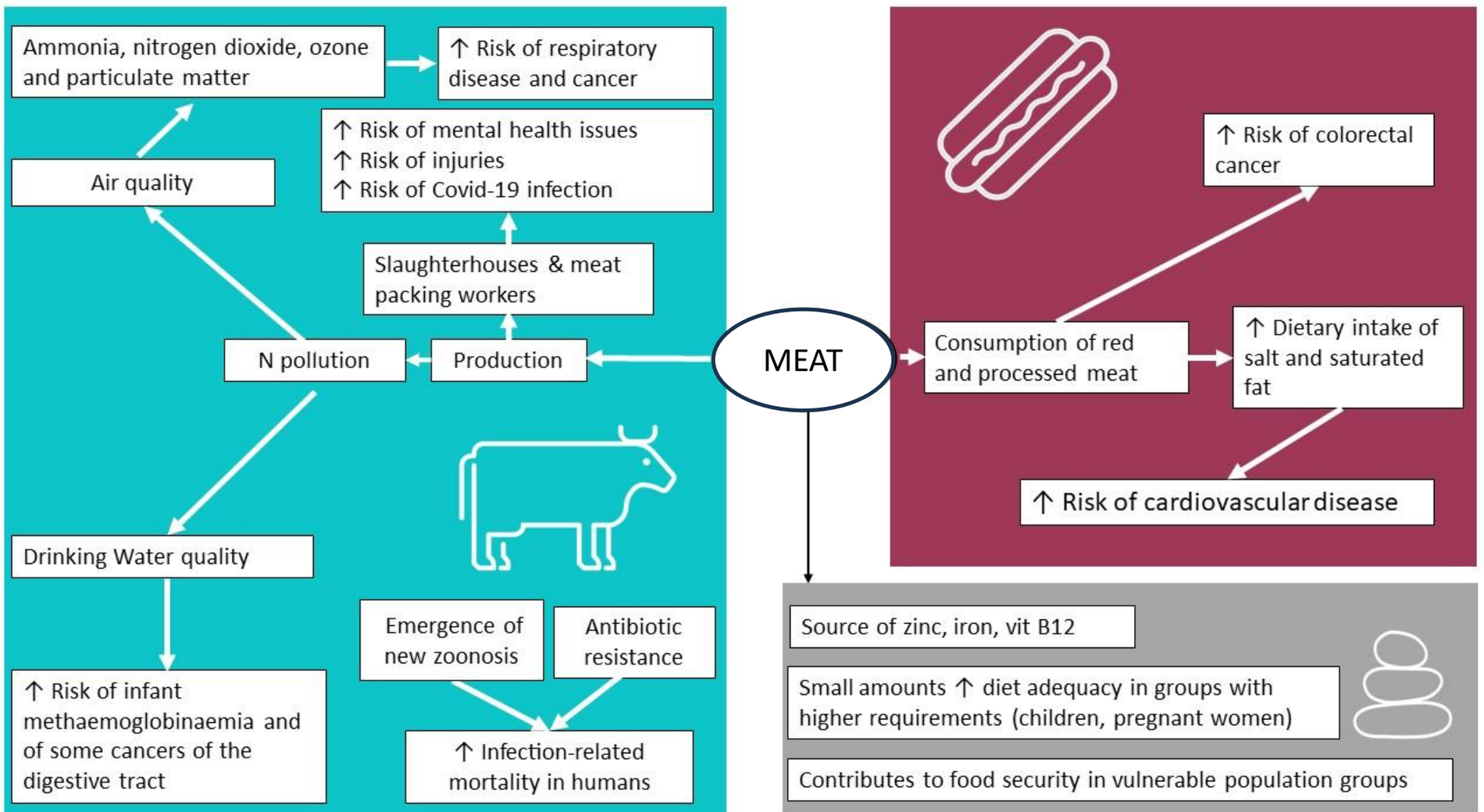
Food system options for nitrogen, environment & health





Reducing meat consumption = The elephant in the room?

Meat has multiple health effects – many of them through nitrogen pollution



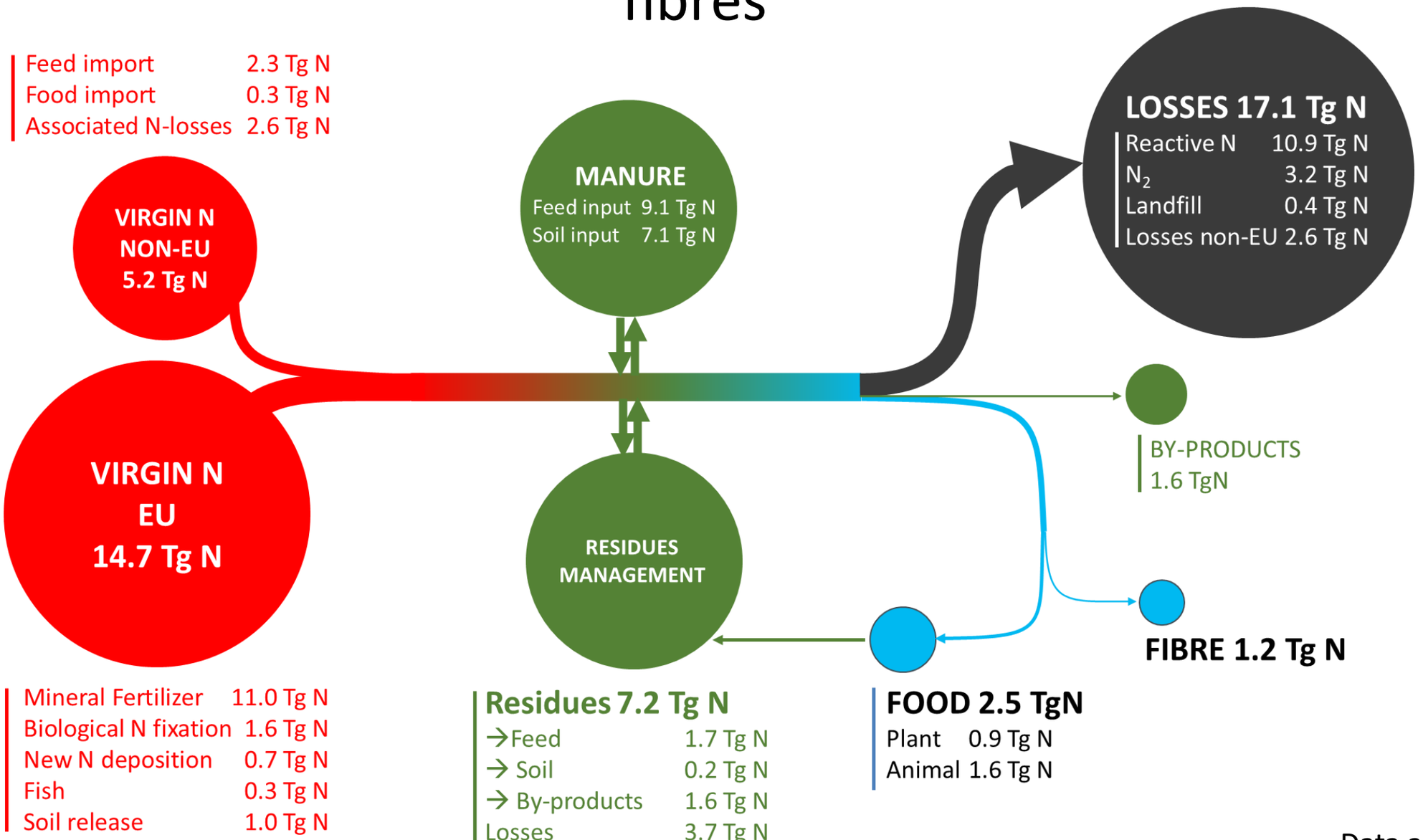
WHAT DID WE DO?

1. Update research on nitrogen options at **farm level**, in the **food chain** and through **dietary shift**

2. Combining results a new model to *explore solution space* to reach 50% **nitrogen waste reduction** and calculating other nitrogen results

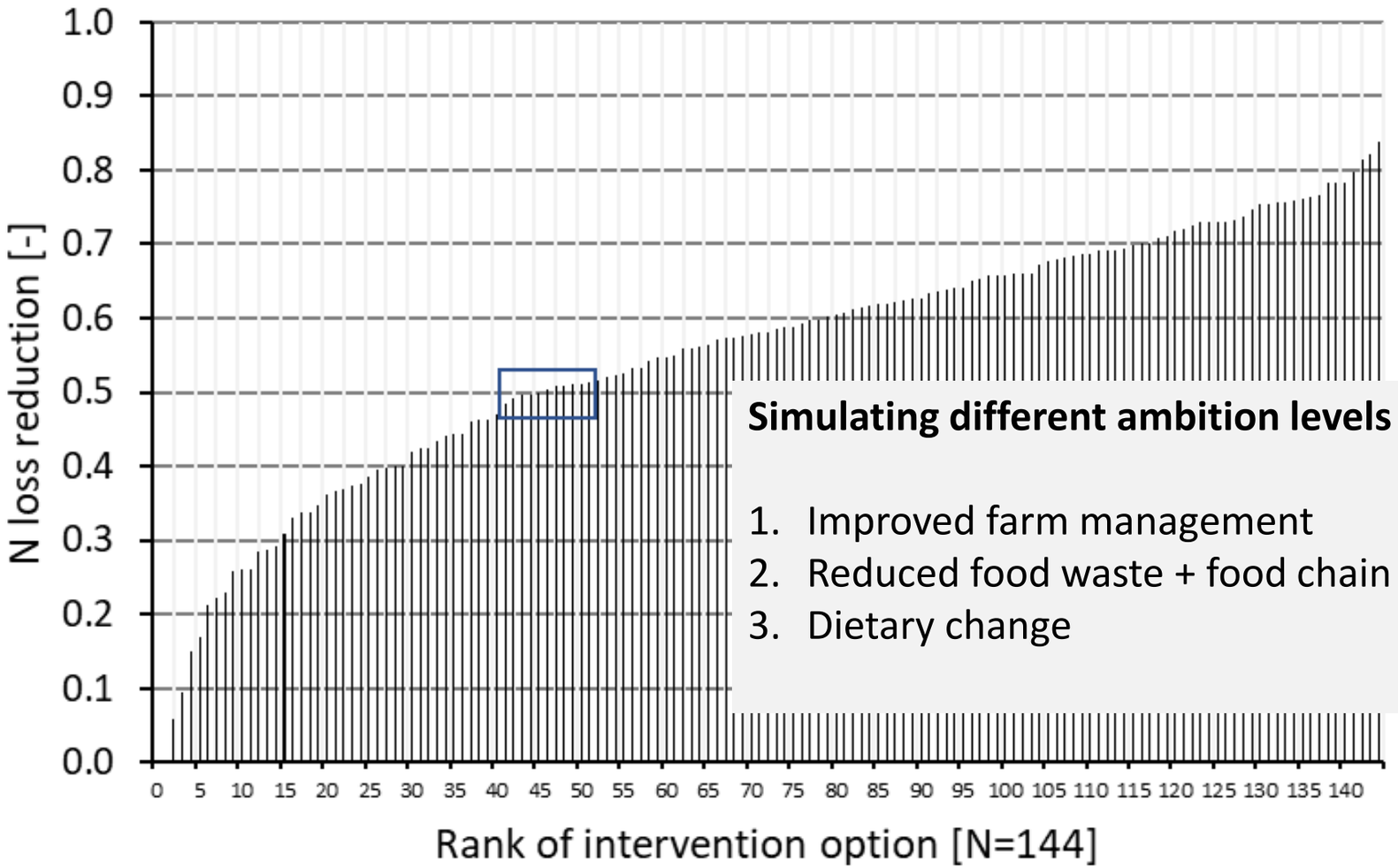
3. Adding a *semi-quantitative cost-benefit analysis* to estimate an **overall score for the net social benefit**

Only 18% of nitrogen input is consumed in food or used as fibres



Data around 2015

There are many options to reduce nitrogen waste by 50% - combining most ambitious measures a reduction by 84% is possible



Simulating different ambition levels for:

1. Improved farm management
2. Reduced food waste + food chain residues management
3. Dietary change

Exploring the option space to reach 50% nitrogen waste reduction

Example scenario	**Farm level** **Ambition**	**Food chain** **Ambition**	**Healthier energy intake** **% reduction**	**Healthier protein intake** **% reduction**	**Diet**	Virgin nitrogen Tg N yr^{-1} % reduction	**Nitrogen losses** **Tg N yr^{-1}** **% reduction**	NUE food system	**Overall score for net societal benefit**	
Baseline	**Baseline**	**Baseline**	**0%**	**0%**	**Default**	16.0 0%	**12.4** **0%**	19%	**0**	baseline
O41	**Low**	**Intermediate**	**13%**	**20%**	**Demitarian**	9.4 41%	**6.4** **49%**	27%	**0.8**	←
O45	**High**	**Improved**	**0%**	**0%**	**Default**	10.0 37%	**6.2** **50%**	32%	**-0.6**	← 50% nitrogen waste reduction
O48	**Medium**	**Intermediate**	**13%**	**0%**	**Vegetarian**	9.7 40%	**6.1** **51%**	32%	**0.4**	
O51	**Baseline**	**Baseline**	**13%**	**0%**	**Vegan**	9.5 41%	**6.0** **51%**	32%	**0.5**	←
O144	**High**	**Improved**	**25%**	**40%**	**Vegan**	4.3 73%	**2.0** **84%**	47%	**0.0**	Most ambitious

MODEL SET-UP

MODEL RESULTS

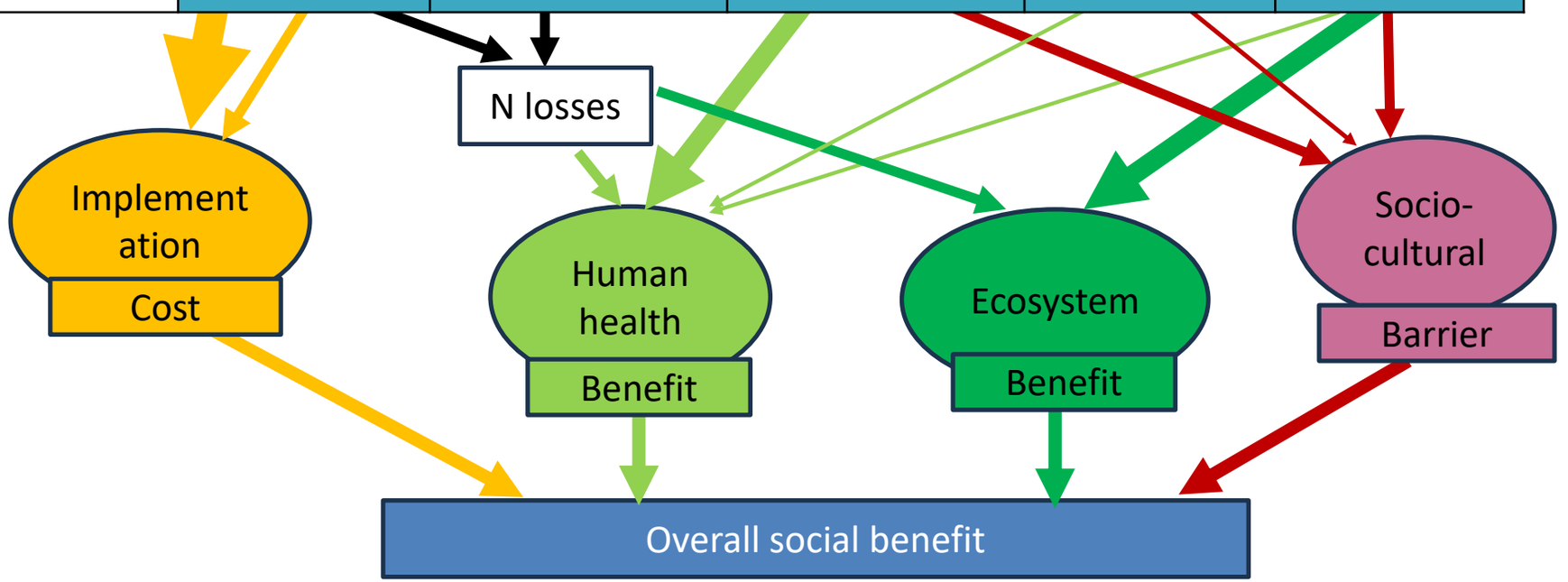
To reach 50% nitrogen waste reduction, demitarian diet with a combination of low and medium ambition levels for on-farm and food chain nitrogen waste reduction and reduction of excess energy and protein intake gives highest overall social benefit

1. SCORING THE EFFECT

Level of ambition	Reduction of farm N losses	Reduction of food system N losses	Reduction of energy intake	Reduction of protein intake	Diet
0	Baseline				
1	**Low**				**Demitarian**
2	Medium	**Intermediate**	**12.5%**	**20%**	Vegetarian
3	High	Improved	25.0%	40%	Vegan

2. AGGREGATING TO IMPACT

3. CALCULATING OVERALL SCORE



Calculating food chain N losses

[Calculation of N targets - Leip et al. 2022 - Rendered code](https://github.com/aleip/Ntargets/blob/main/leip_ntargets.Rmd)

Demand scenarios

EN: Reduction of energy overconsumption. According to *Verma van den Boos (2020)*, energy overconsumption in the EU28 is 50% (3443 kcal/cap/day versus 2156 kcal/cap/day as calculated from bodymetric data). Accordingly, a reduction of 37.4% is possible. We define a medium and a high ambition scenario of **reducing energy overconsumption by 1/3 or 2/3**, respectively, corresponding to a reduction of **overall energy consumption of 12.5% and 25%,** respectively. Most of the reduction of overconsuption is achieved in the **vegetable sector (80%)** and only a smaller part in the **animal sector (20%).**

PR: Reduction of protein overconsumption. According to *Corrado et al. (2020)* there is a protein consumption (intake) of 101 g prot/cap/day. Corresponding to an annual N intake of 2978 kN N consumed per year in the EU28 (population ca 500 millions in 2011, Eurostat). We calculate protein reduction scenarios achieving **40% and 80% reduction of the overconsumption**, corresponding to a **reduction of 20% and 40% of protein intake**, respectively. We assume protein reduction to be achieved **solely over animal source food**. The PR scenarios do not assume a shift in the composition of the food products.

DS: Dietary shift. Shift of the diet from products with higher footprints - products with lower footprints. Generally, this will be driven by non-nitrogen environmental concerns, however, there is large correlation between GHG and N footprints.

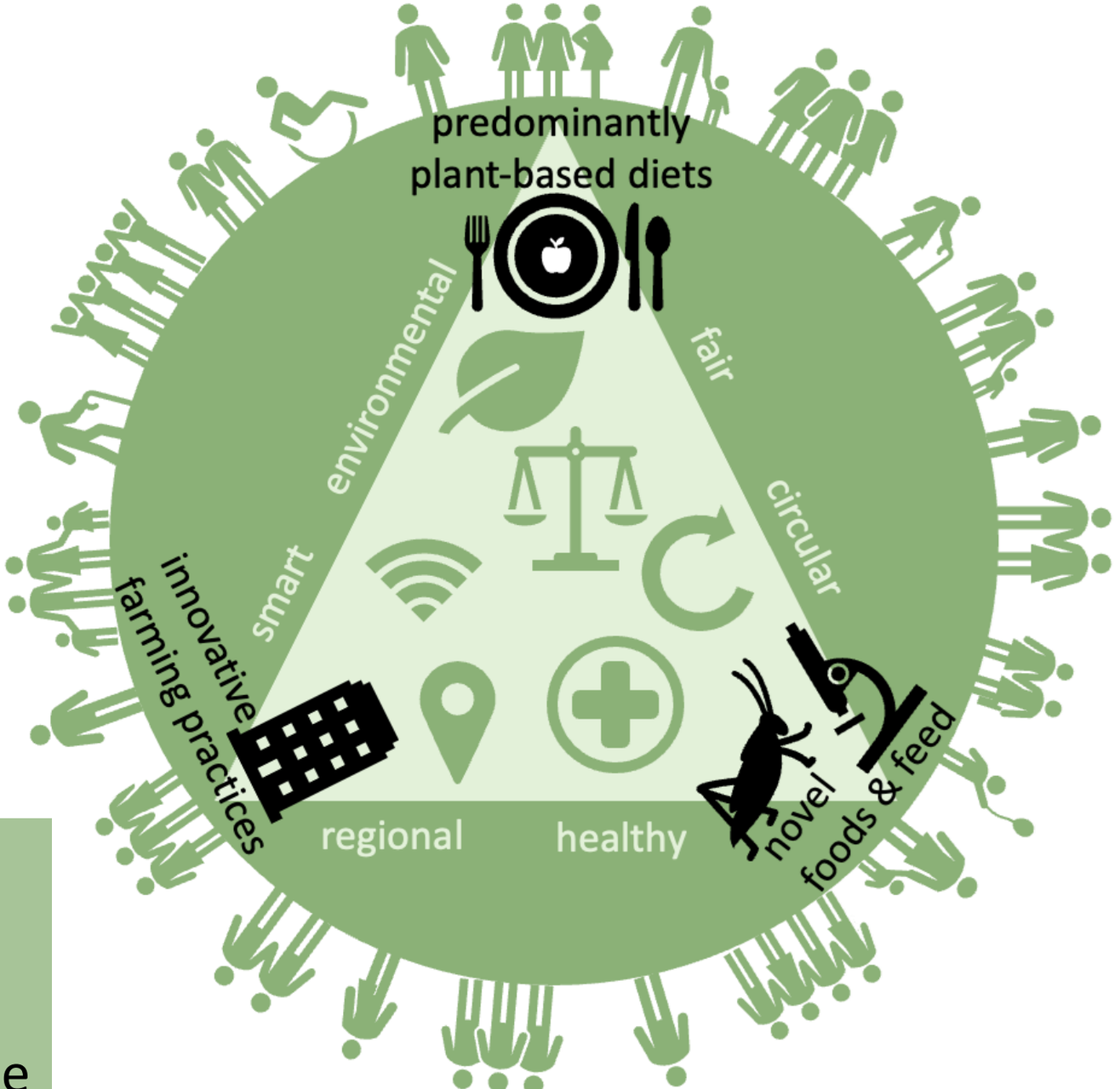
- ***Vegan*** (ds==3): Substitution of meat and other animal source foods with substitutes
- ***Demiterian*** (ds==1): As vegan, but only with half reduction of meat
- ***Vegetarian*** (ds==2): Substitution of meat with other dairy, eggs, and vegetable products (50%). However, there is co-production of meat/milk and meat/eggs which is assumed to be consumed.

- Crops: 50%
- Plant-based analogues: 30%
- Cellular food: 5%
- Seafood: 10%
- Insects: 5%

HOW DO LOW-NITROGEN FOOD SYSTEMS LOOK LIKE?

For example:

- Agroecology
- Mediterranean systems
- ‘Visionary’ (high tech) systems

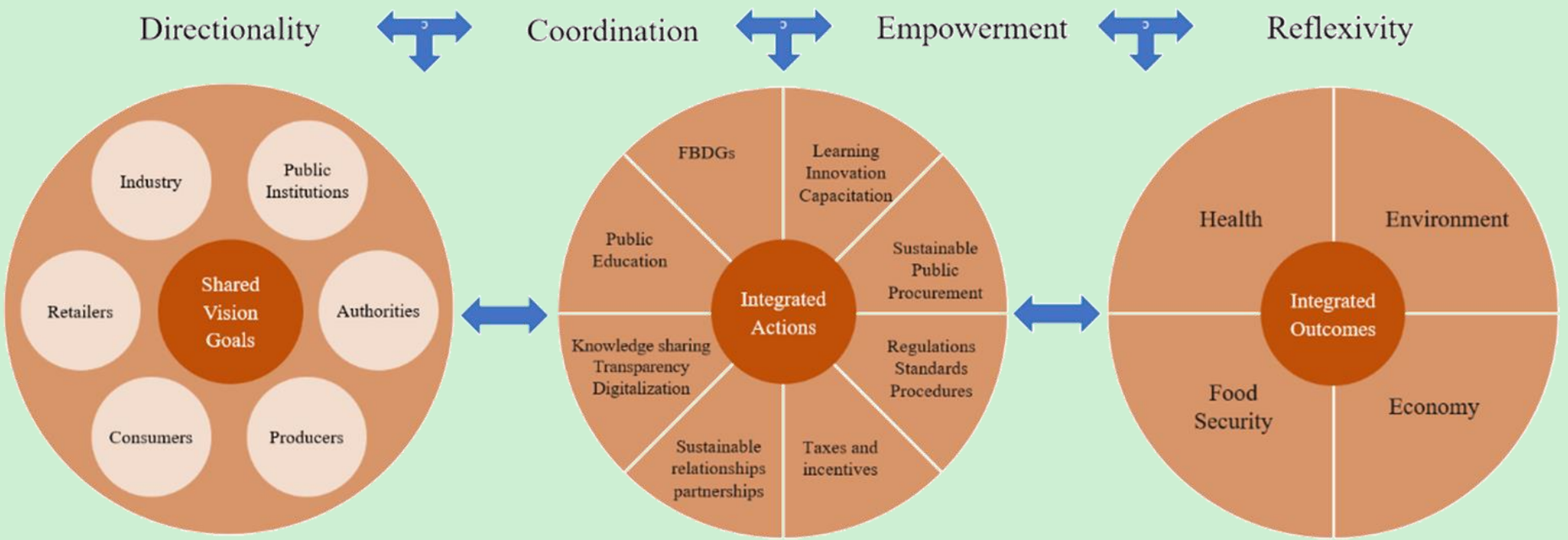


Sustainable food systems low in nitrogen waste can have *many different forms* & depends on the **context** and the **preferences** of people

Appetite for *change*

- Unsustainable N-use
- Unhealthy diets
- Food system actors don't collaborate

Governance platform for system change



To *achieve*

Mobilisation of and cooperation between **all** actors

Joint analysis of food systems and identification of levers for shared vision

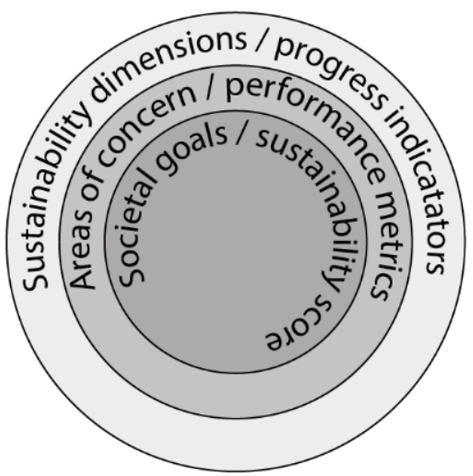
dialogues between actors from **local to regional,** from **farmers** and **consumers** to **regulatory authorities**

Scaling up of actions, **experimentation** and **new thinking**

Enabled incentives for long-term change

MAKING LOW-NITROGEN FOOD SYSTEMS LAST…

The challenge of reducing nitrogen waste and the transformation towards sustainable food systems is multi-dimensional



Food systems' sustainability can be measured against four societal goals:

1) **Adequate, safe, healthy and affordable diets for all;**
2) **A clean and healthy planet;**
3) **Economically thriving food systems, supportive of the common good;**
4) **Just, ethical and equitable food systems.**

CONCLUSION

The most feasible strategies to reduce nitrogen losses in agriculture by 50% will combine diet change towards plant-based diets with intermediate ambitions of farm level and food chain measures

Dietary changes reduces the socio-economic cost of achieving ambitious nitrogen reduction targets

THANK YOU

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