Importance and future of fertilizers for world nutrition

Bedeutung und Zukunft der Düngung für die Welternährung

Welternährung – Quo vadis, 12 October 2022, Dachverband wissenschaftlicher Gesellschaften der Agrar-, Forst-, Ernährungs-, Veterinär- und Umweltforschung , Berlin

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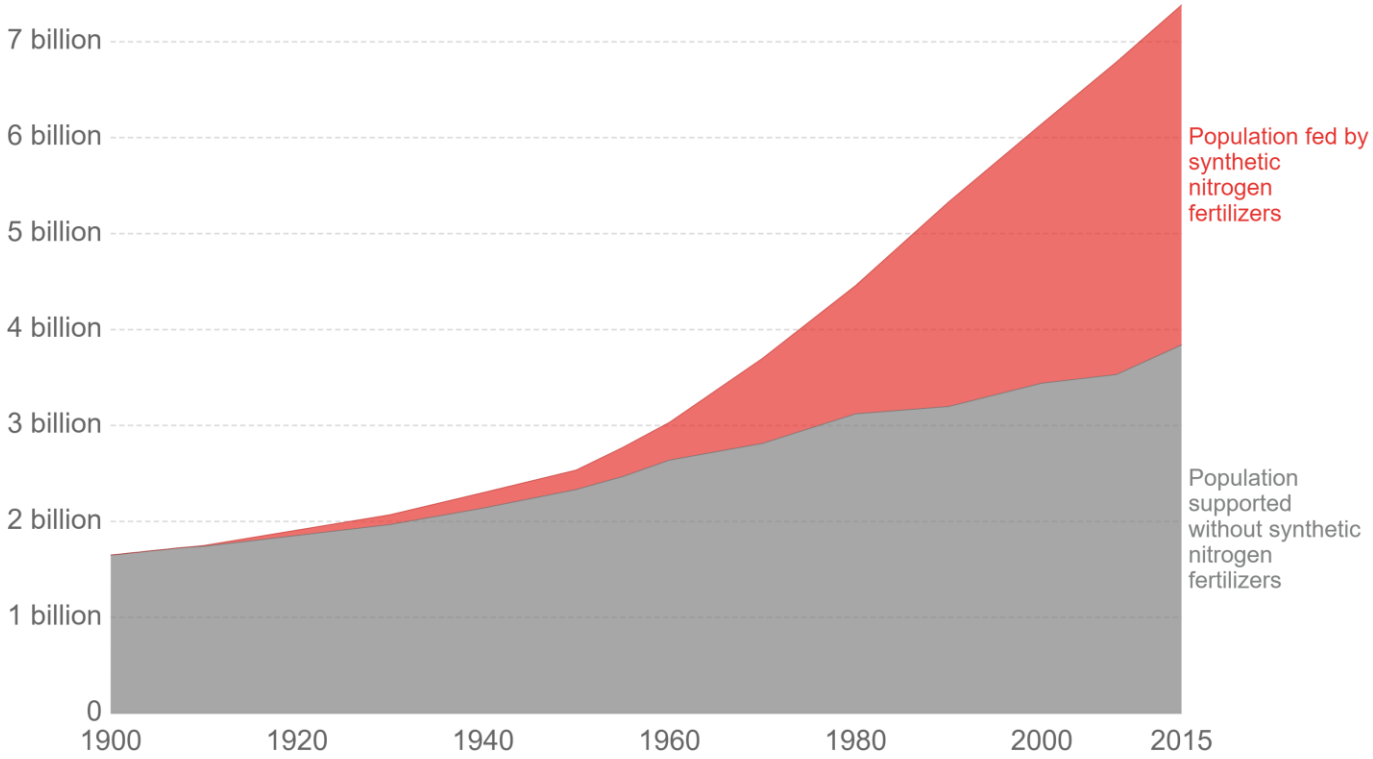
World population supported by synthetic nitrogen fertilizers

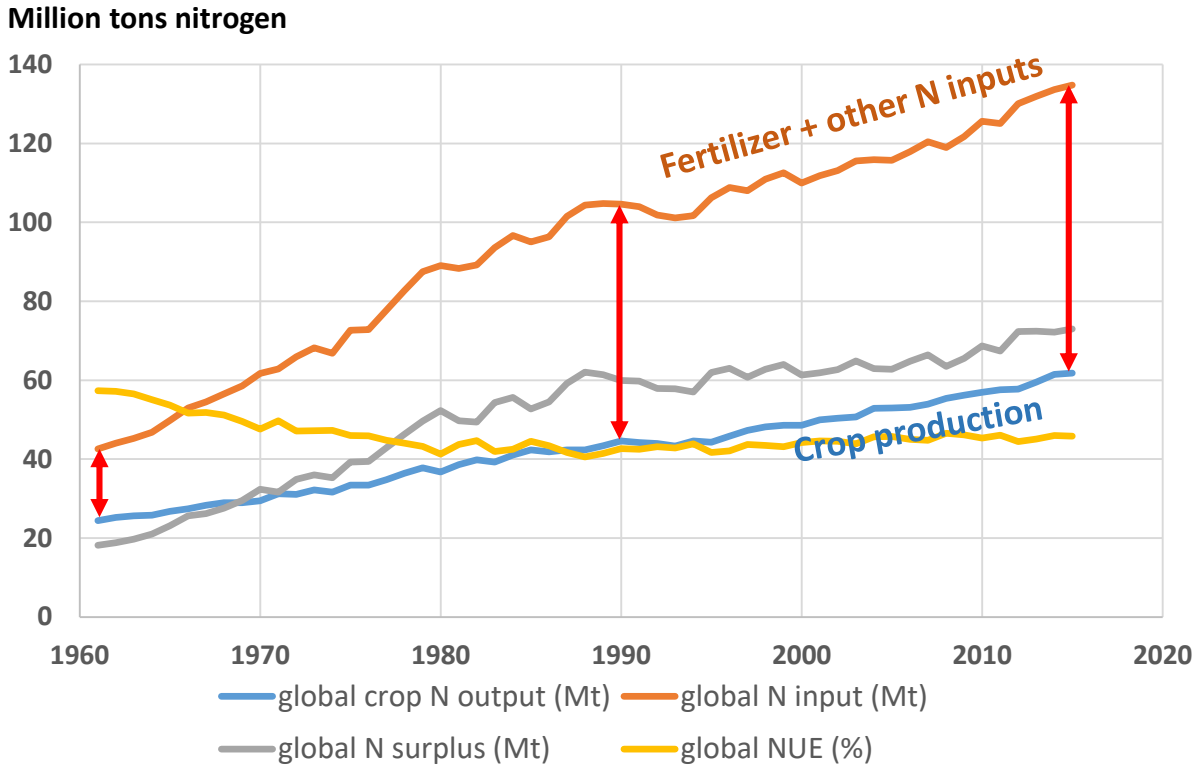
Our World in Data

Estimates of the share of the global population which could be supported with and without the production of synthetic nitrogen fertilizers (via the Haber-Bosch process) for food production. Best estimates project that just over half of the global population could be sustained without reactive nitrogen fertilizer derived from the Haber-Bosch process.



Source: Erisman et al. (2008); Smil (2002); Stewart (2005)

Global crop production heavily depends on plant nutrients



Global trends in crop nitrogen inputs and outputs (million t)

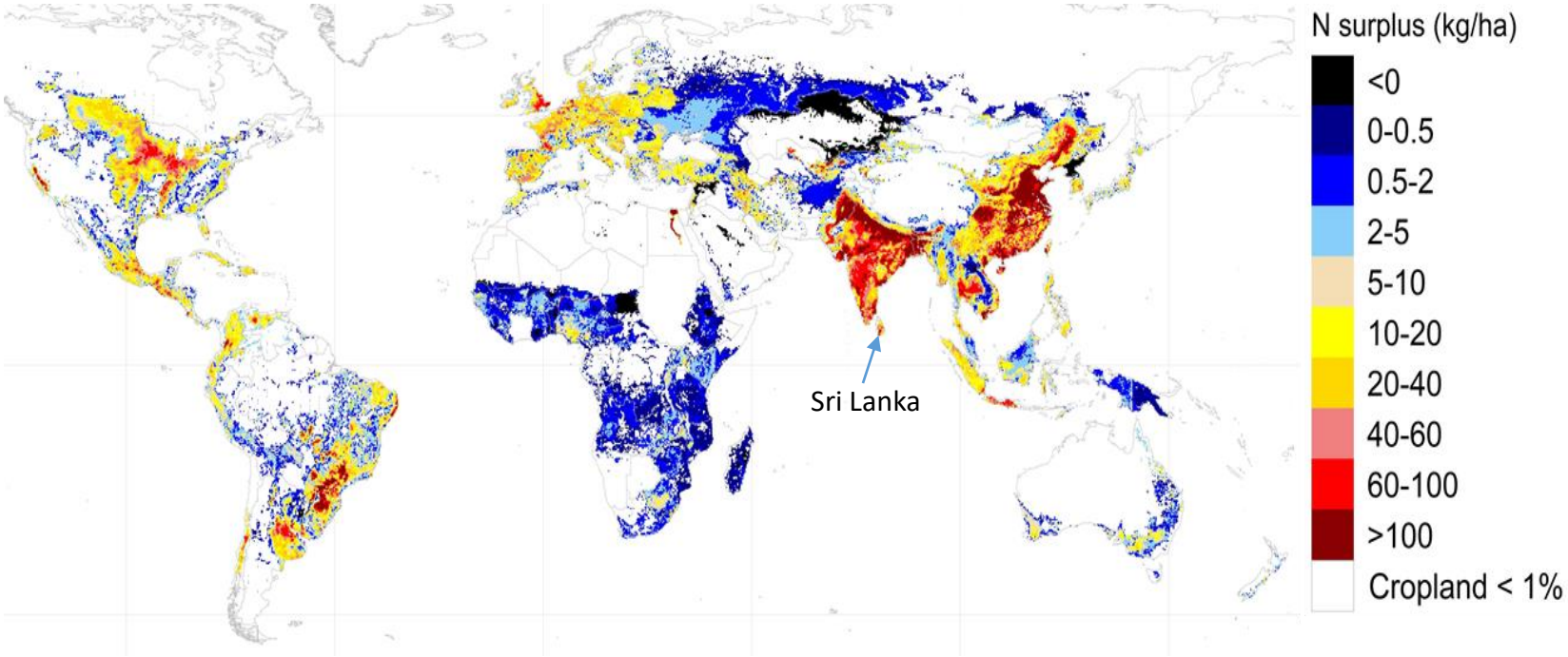
N surplus = total N input to cropland minus harvested N as crop products

NUE = harvested N as crop products/total N input to cropland

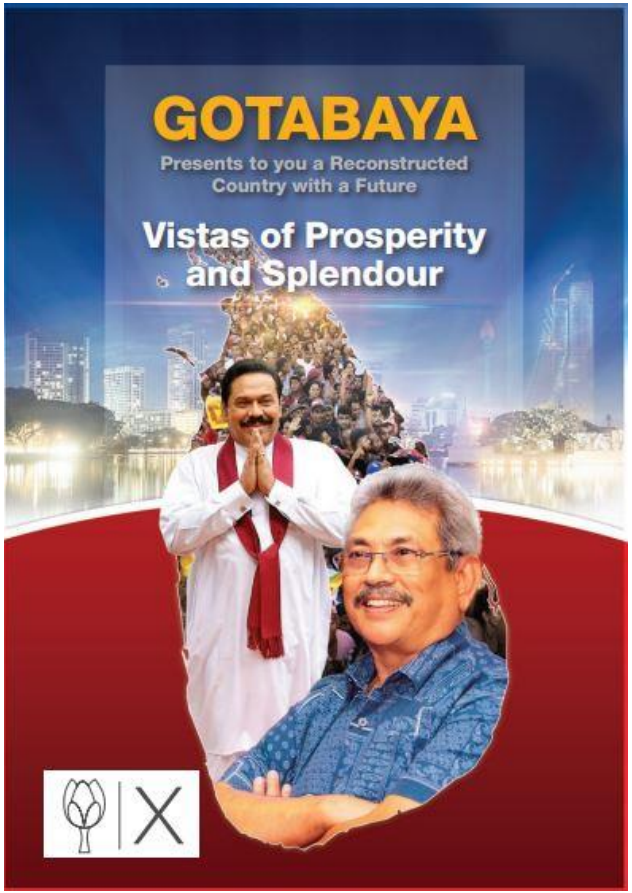
Source: Xin Zhang and Guolin Yao, University of Maryland Center for Environmental Science

Cropland nitrogen surplus or deficit in 2015 (kg N/ha)

N surplus (or deficit) is defined as the total N input to cropland minus N harvested as crop products



Source: Xin Zhang and Guolin Yao, University of Maryland Center for Environmental Science



Sri Lanka

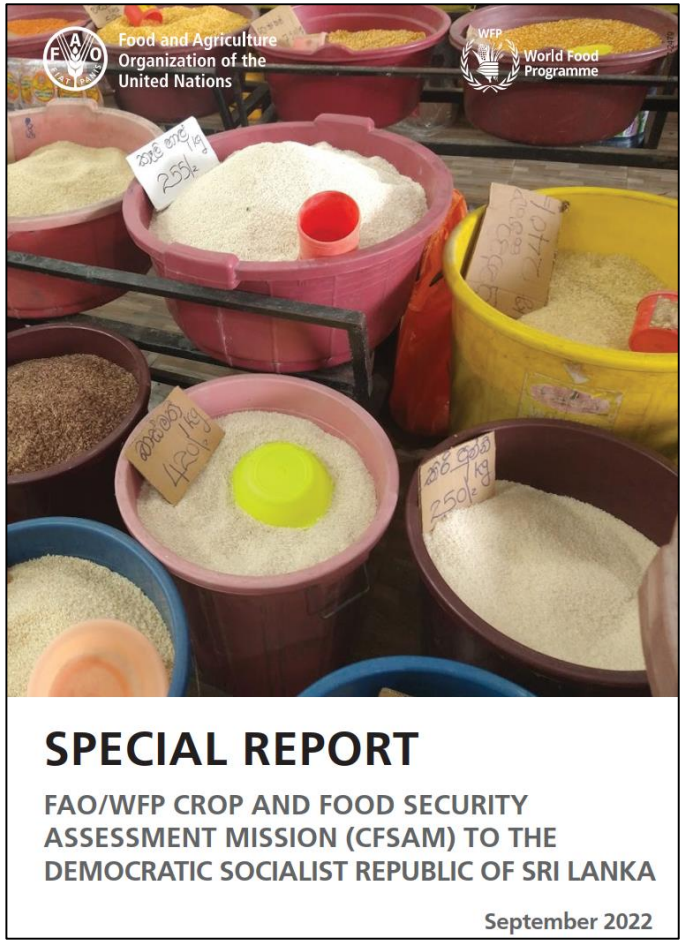
Vistas of Prosperity and Splendor Chapter 5: People-Centric Economy, Page 39

A Revolution in the Use of Fertilizer

Build a community of healthy and productive citizens

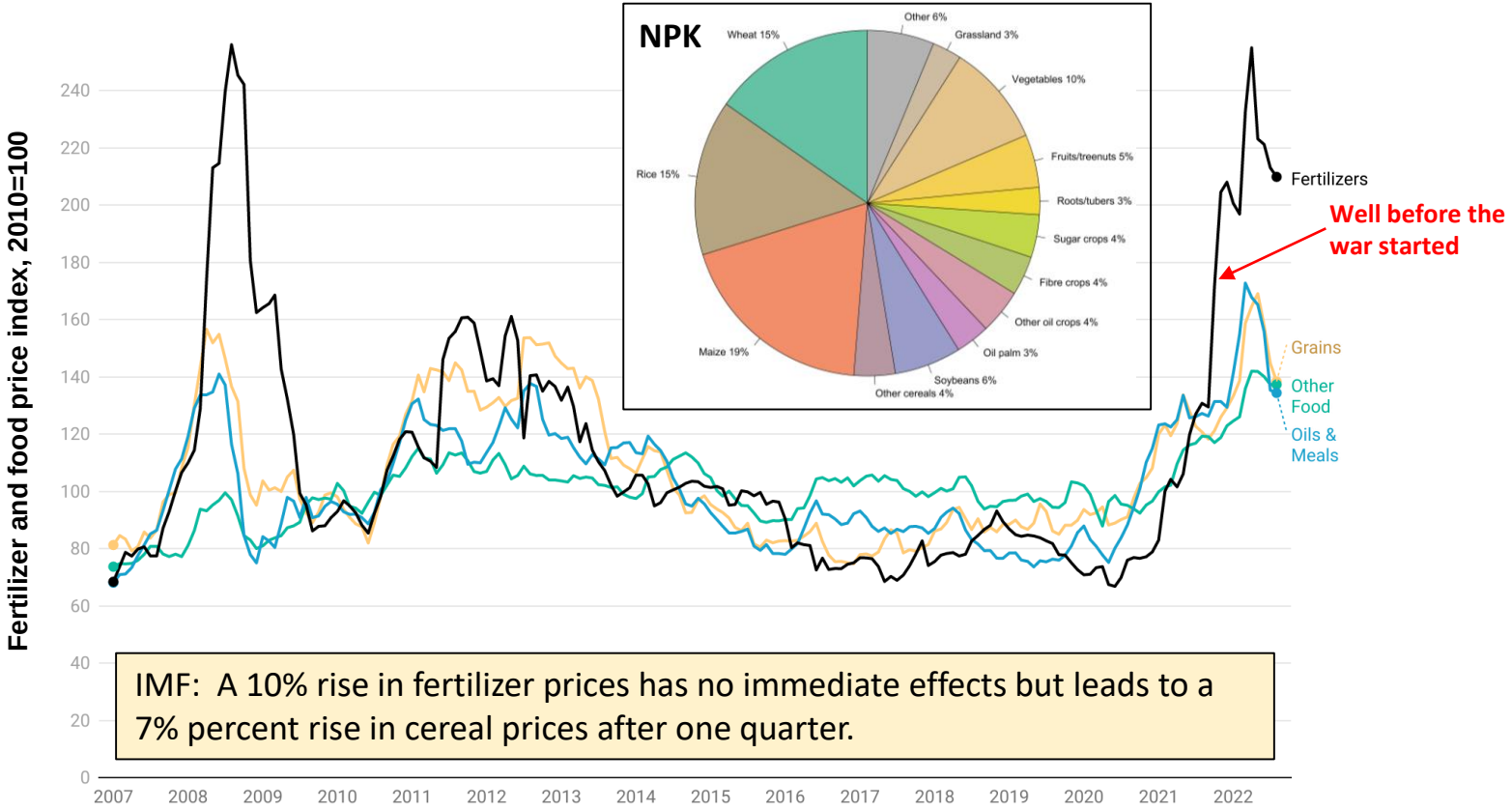
- develop the habit of consuming food with no contamination with harmful chemicals.
- the entire agriculture will be promoted to use organic fertilizers during the next ten years.
- production of organic fertilizer will be accelerated.

6 May 2021: Banned imports of agrochemicals with immediate effect, including fertilizers



- Rice yields down 42%
- Maize yields down 40%; production down 61%
- Vegetables yields down 38%
- Tea production down 19%, export down 10%
- Record food prices: 90% food inflation rate
- **"The situation is likely to deteriorate during the lean season from Oct 2022 to Feb 2023."**

Fertilizers and food prices are strongly correlated



IMF: A 10% rise in fertilizer prices has no immediate effects but leads to a 7% percent rise in cereal prices after one quarter.

Source: WB Commodity Price Data (The Pink Sheet); Insert: Global fertilizer use (N+P+K) by crops in 2018 (IFA 2022)

It is rare for the fertilizer supply chain to encounter so many disruptions in a short space of time

Physical disruption

- ✓ War in Ukraine
- ✓ Asset freeze of some Russian assets

Production below capability (Europe: 70% down)

Economic disruption

- ✓ Higher costs
  - ✓ Natural gas and coal
  - ✓ Ammonia and sulphur
  - ✓ Fuel and electricity
- ✓ Spiralling freight costs

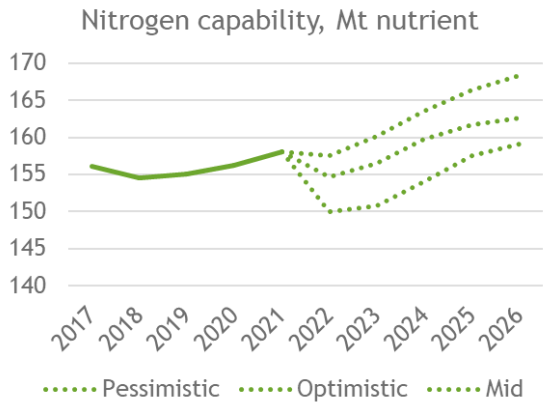
High production & delivery costs

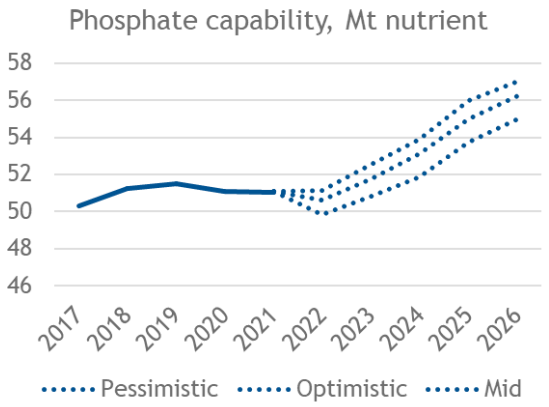
Geopolitical disruption

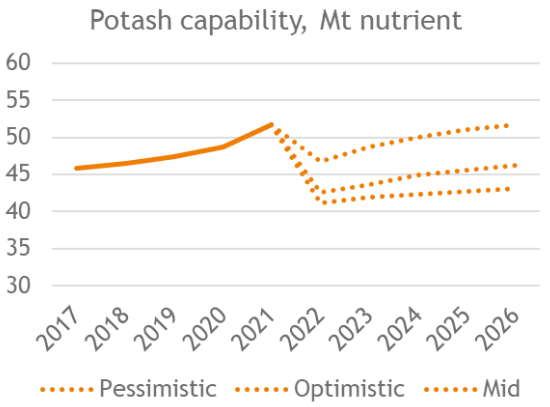
- ✓ Sanctions on Russia and Belarus
- ✓ Export restrictions amid availability concerns (→China)

Market uncertainty

Potash capability is forecast to be most constrained, followed by nitrogen, and then phosphate







Nitrogen
Wide-spread scenarios based on gas economics and ability to trade with "friendly" countries

29% traded

Phosphate
Narrow-spread scenarios with more upside in the medium-term from capacity expansions

48% traded

Potash
Scenarios skewed to the downside based on sanctions and likely ability to export

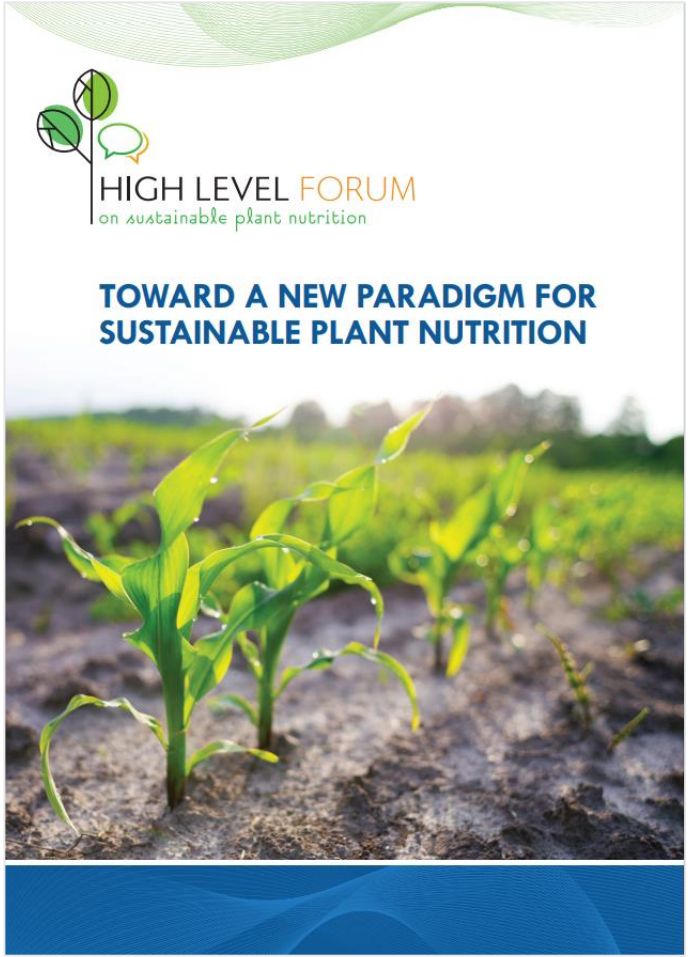
82% traded

Source: IFA, May 2022

Productivity and food security are still critical needs, but a new paradigm for sustainable plant nutrition must embrace a food systems approach with all of its sustainability dimensions.

IFA High-Level Forum, Versailles, France, November 2019

https://www.highlevelforum.org/



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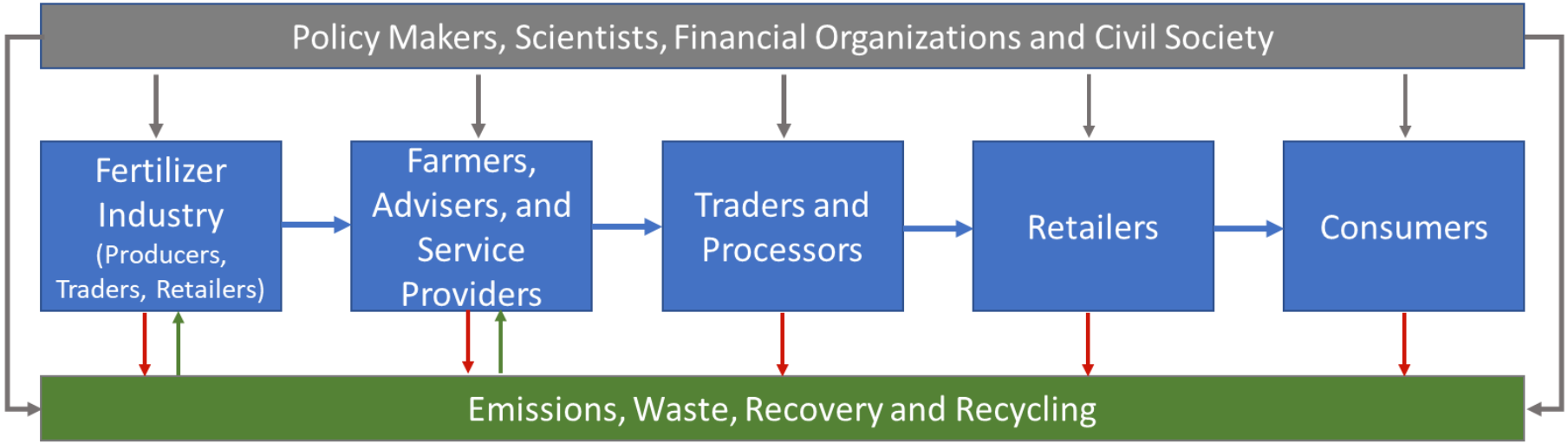
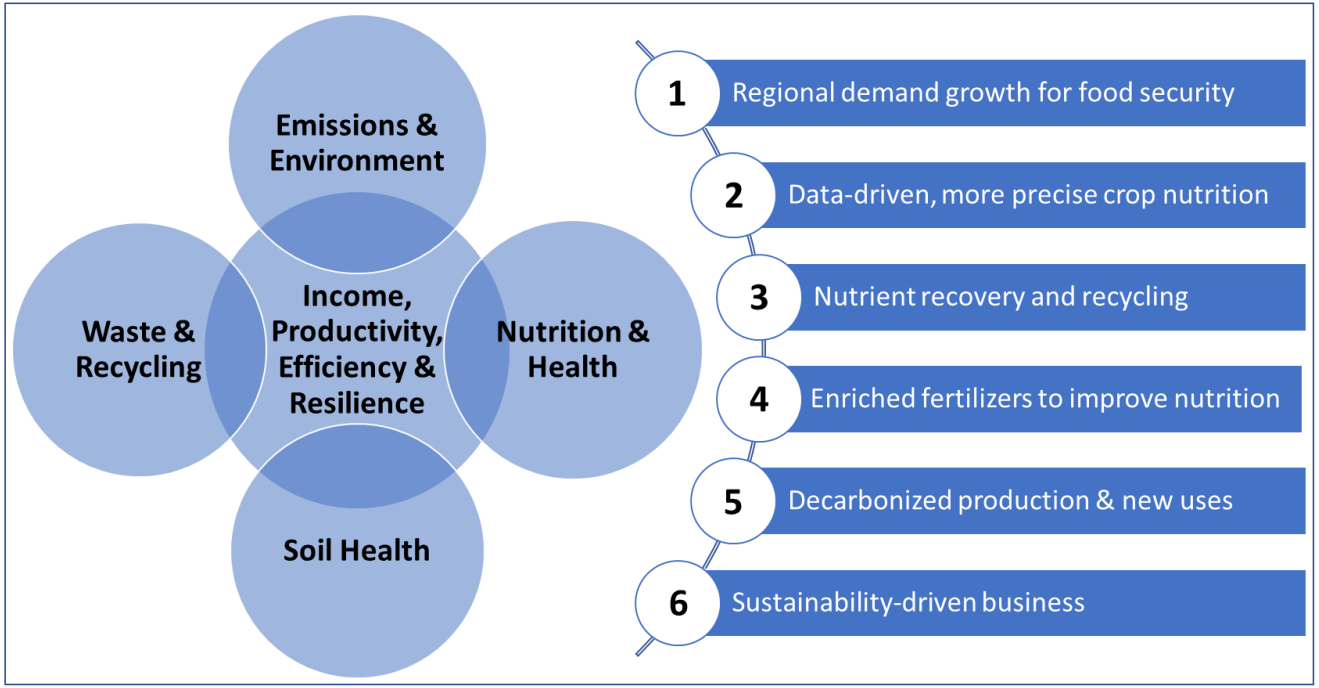
The agri-food chain from a nutrient perspective



Food systems & circular economy thinking
Disruptive technologies
New players, new partnerships
Progressive policies

Responsible Plant Nutrition: 5 aims and 6 key transformations



SCIENTIFIC PANEL
ON RESPONSIBLE PLANT NUTRITION

https://www.sprpn.org/issue-briefs

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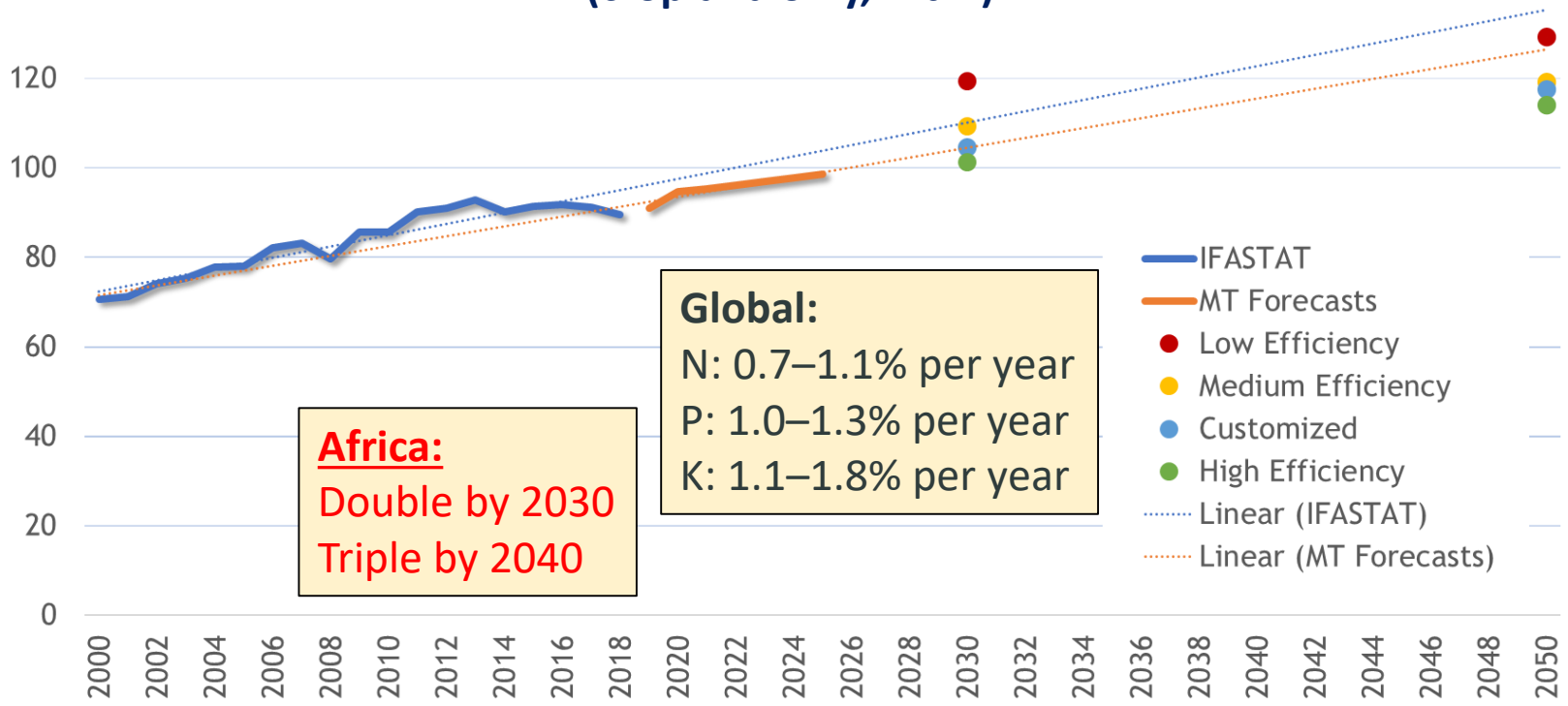
IFA projections of long-term fertilizer N demand

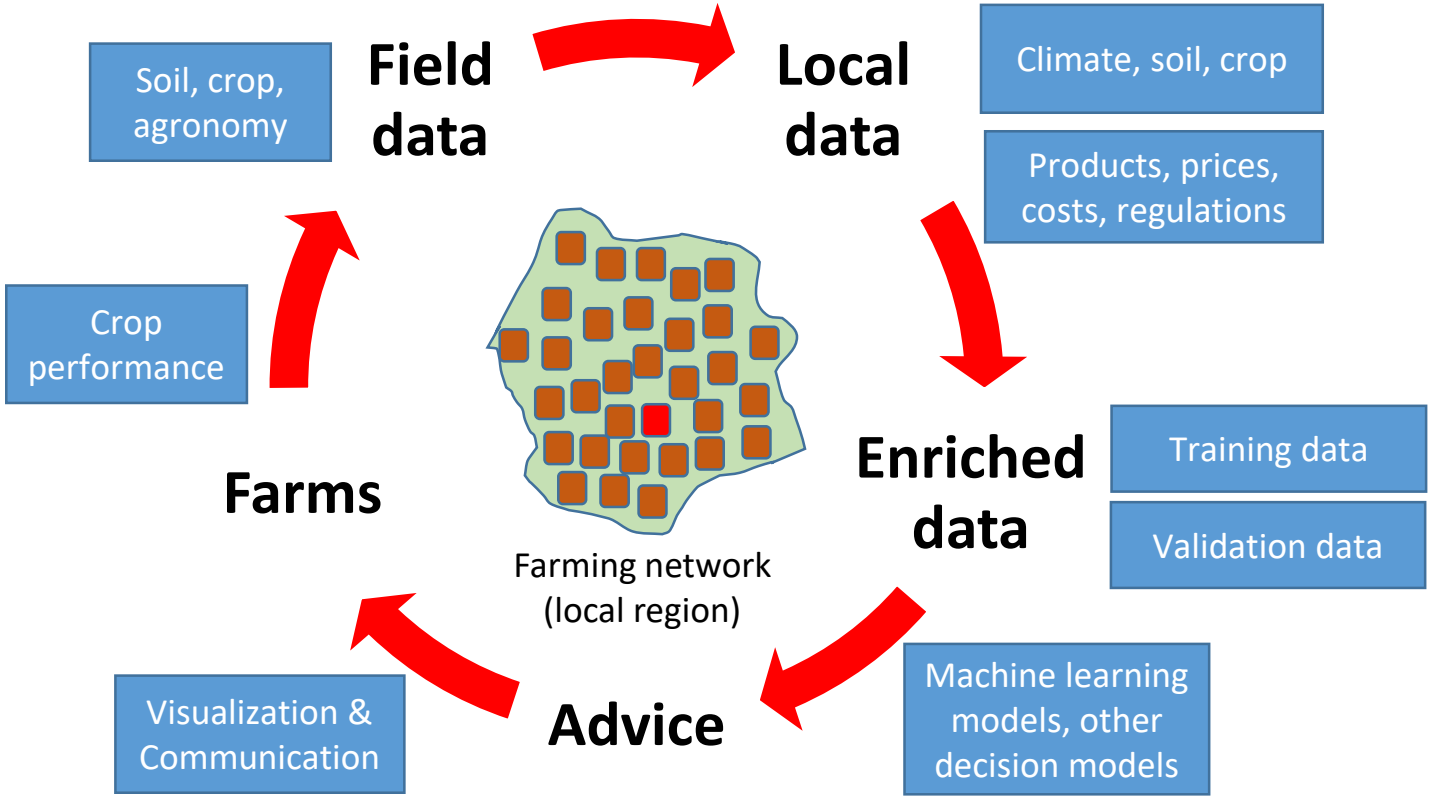
(cropland only, Mt N)



IFA, 2021

2

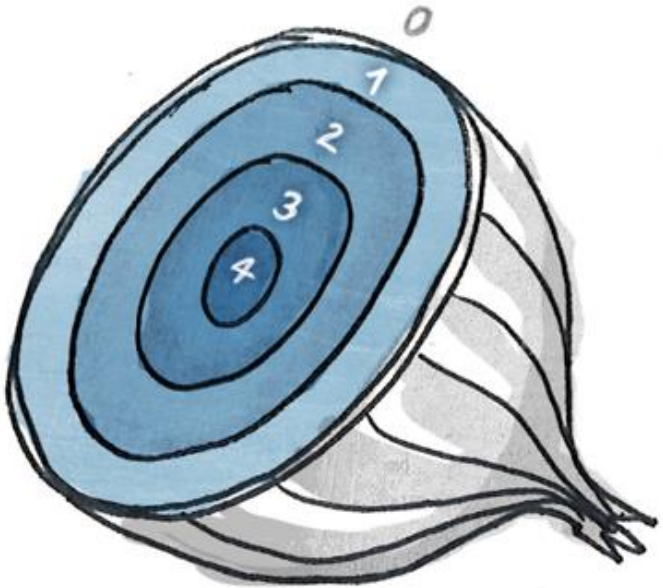
Self-learning, precise crop nutrition advisory?



<u>Key requirement:</u> continuous collection, processing and sharing of field data

Novel fertilizers

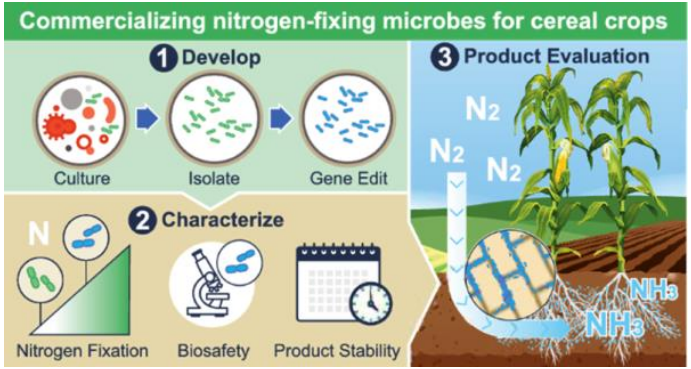
- Tailored, including micronutrients
- Bio-active: gradually accessible to microbes and/or nutrient release triggered by the plant
- Bio-based, fully degradable
- Economical in production and performance
- Safe



How well do such innovations work in reality, and why?

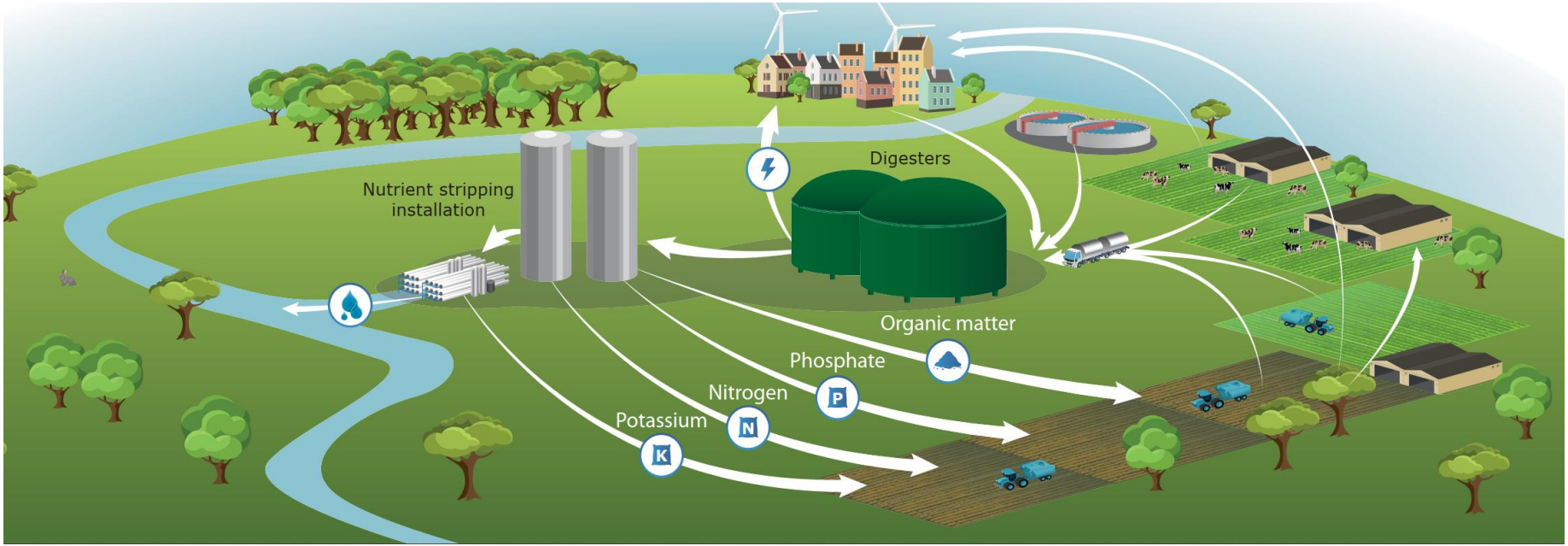
https://lp.icl-sf.com/uk-en/eqox/

https://www.iffco.in/en/nano-urea-liquid-fertilizer



https://www.pivotbio.com

3 Recover and recycle nutrients from all major waste streams



https://systemicproject.eu/

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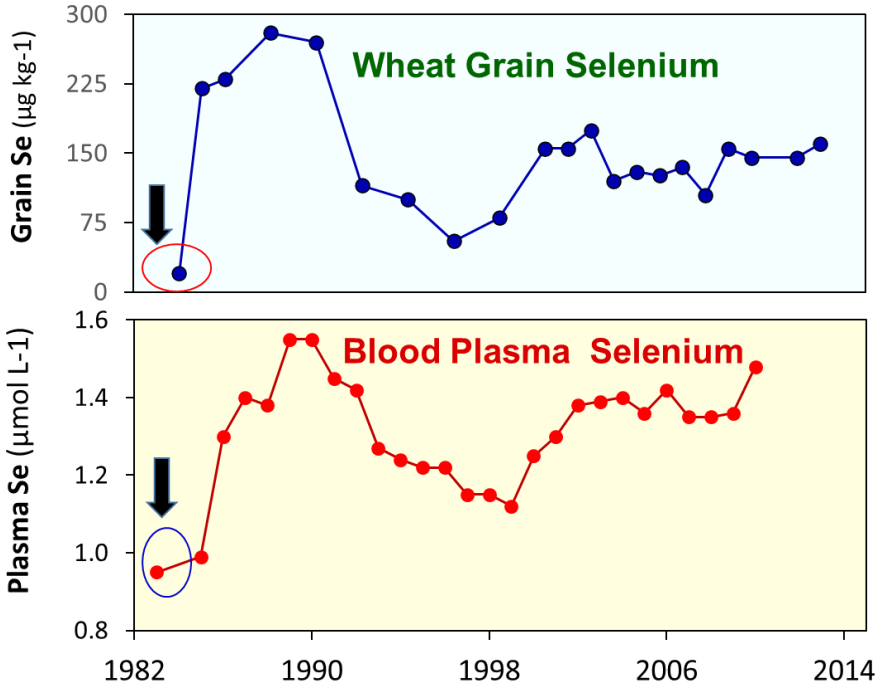
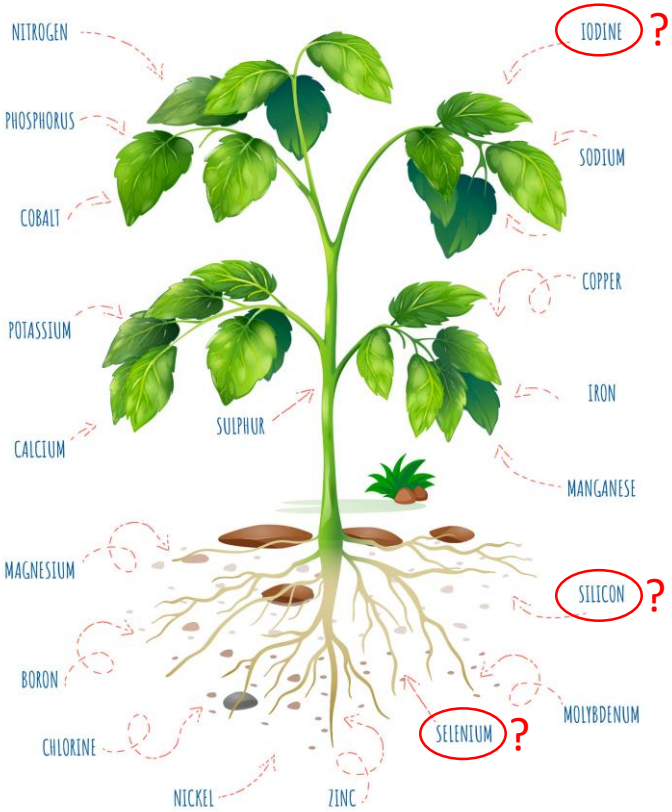
More nutritious crops

Nutrition- and health-sensitive agriculture includes the targeted enrichment and application of fertilizers to deliver micronutrients of importance to crop, animal and human health (e.g. Zn, Se, I).



Changes in grain and blood selenium since 1985 in Finland after Se-enrichment of NPK fertilizers

Rethinking plant nutrients



A mineral plant nutrient is an element which is essential or beneficial for plant growth, development or the quality attributes of the harvested product.

Plant Soil
https://doi.org/10.1007/s11104-021-05171-w

SPECIAL ISSUE S97 - 30 YEARS

Check for updates

What is a plant nutrient? Changing definitions to advance science and innovation in plant nutrition

Patrick H. Brown · Fang-Jie Zhao · Achim Dobermann

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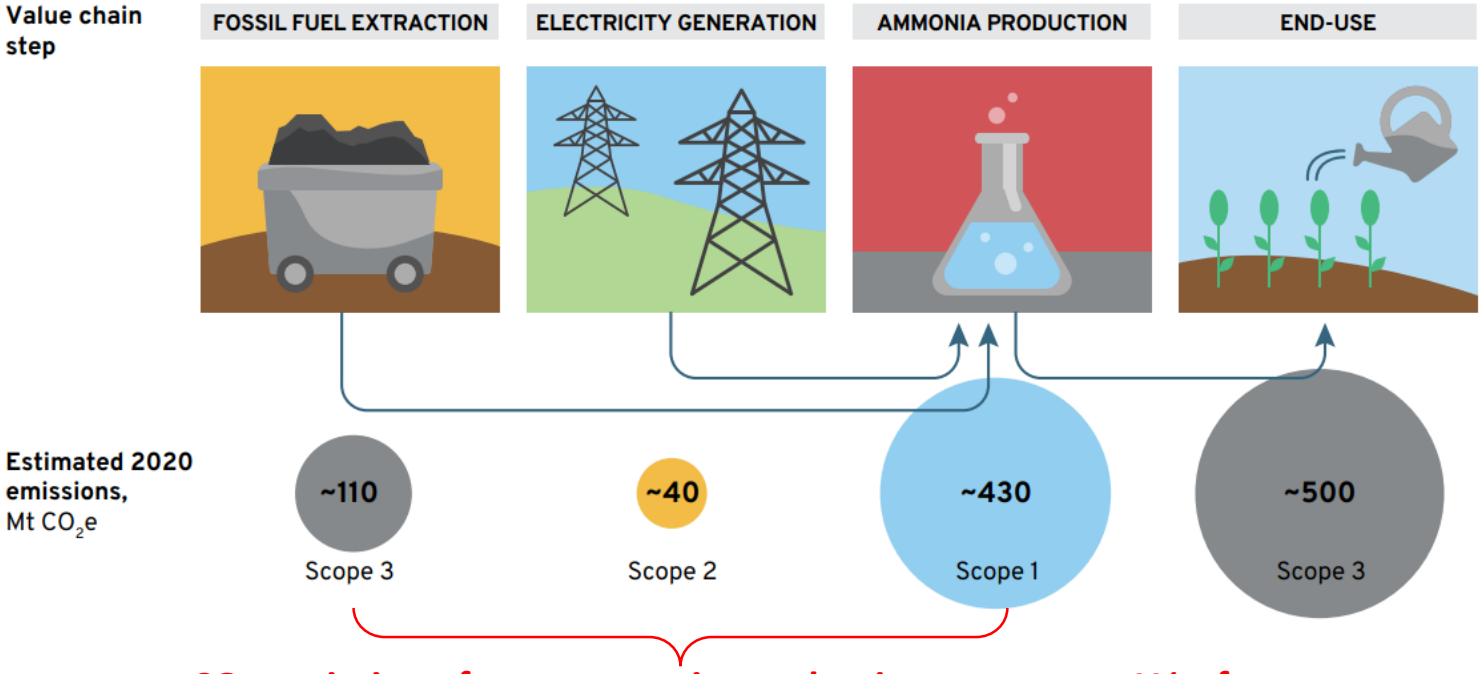
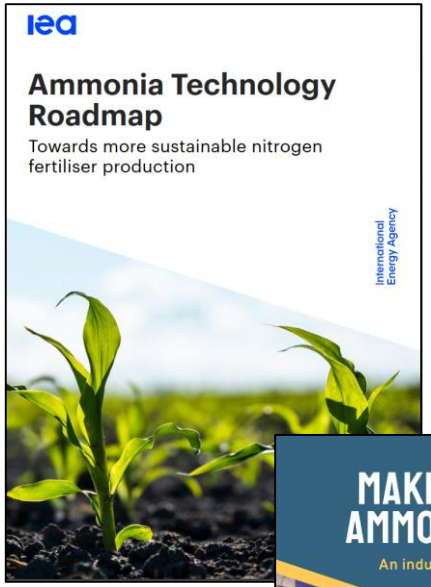
GHG emissions along the ammonia supply chain

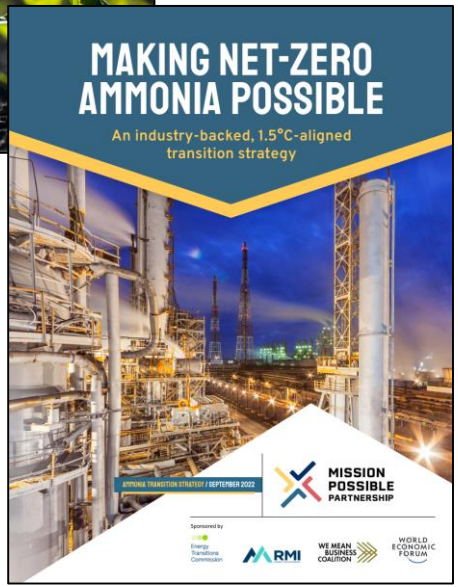


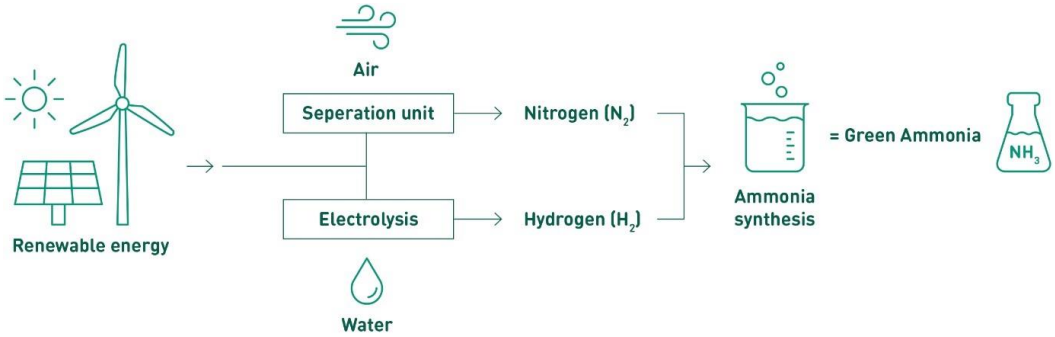
CO_2 emissions from ammonia production represent 1% of all global emissions. Could they be eliminated by 2050?

https://missionpossiblepartnership.org/wp-content/uploads/2022/09/Making-1.5-Aligned-Ammonia-possible.pdf

Green ammonia



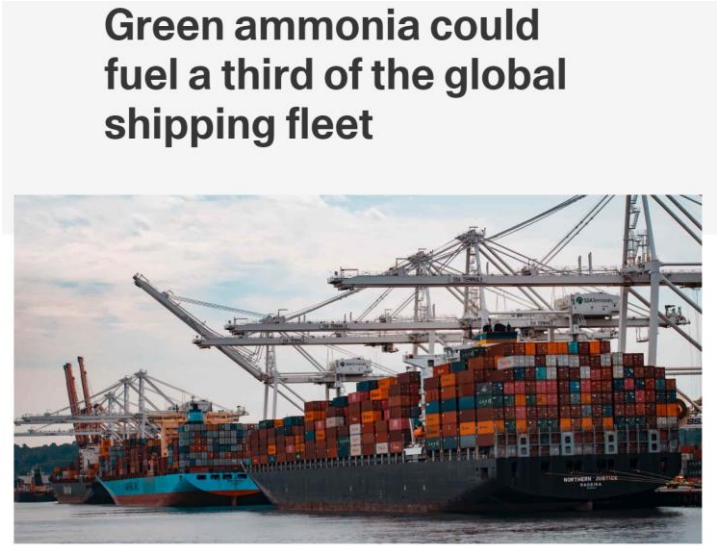


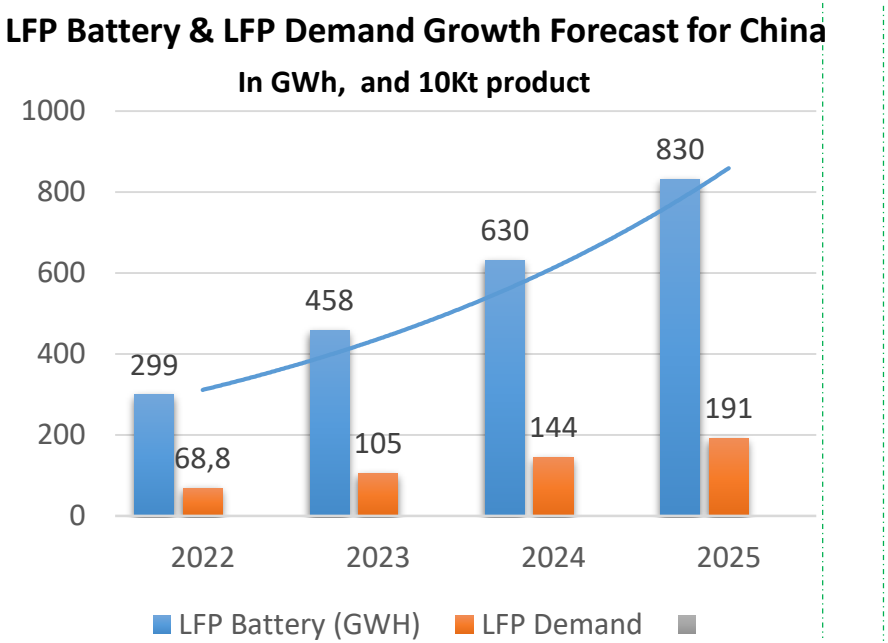


https://www.stamicarbon.com

New industrial uses of fertilizer

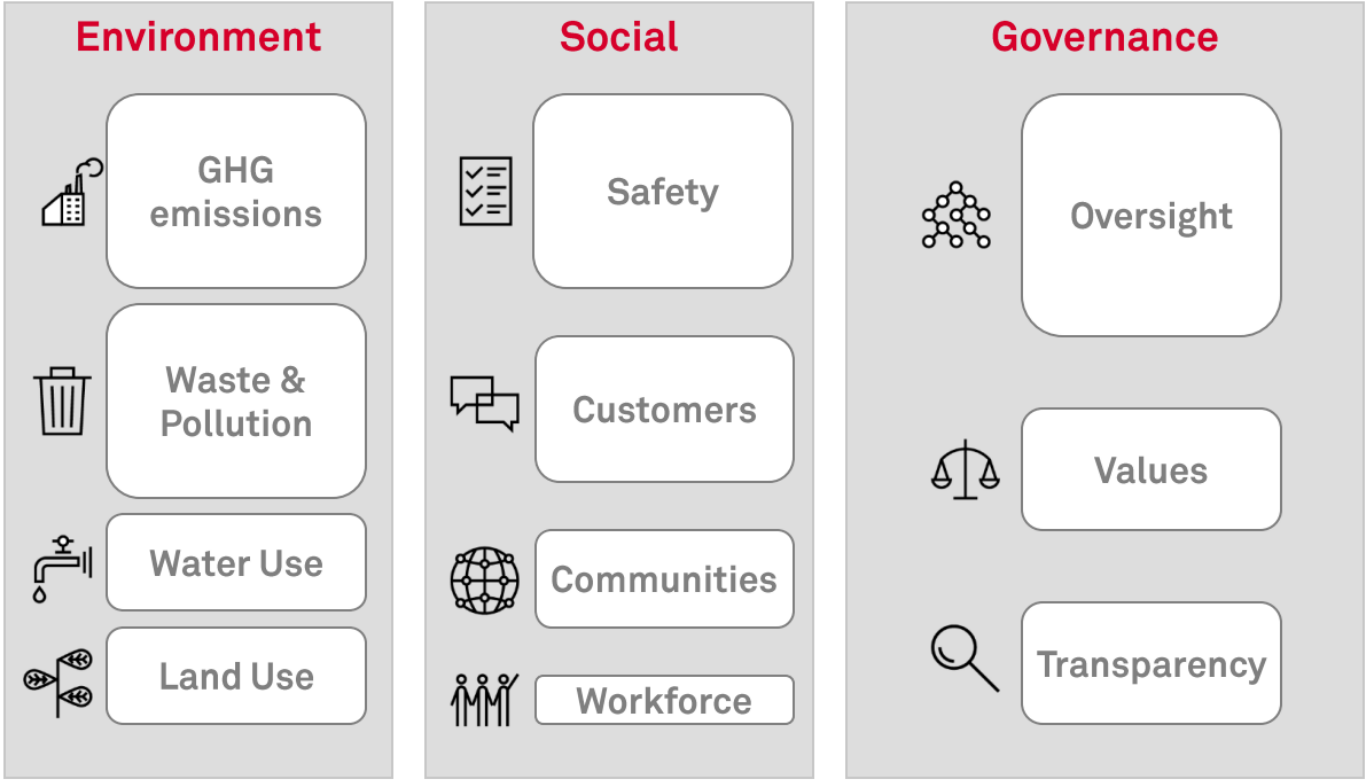
- Green ammonia as energy carrier and zero-carbon fuel
- Lithium ferro-phosphate for batteries
- .....
- .....





Source: Sinochem

Sustainability-driven business



Source: https://www.spglobal.com/_assets/documents/ratings/research/100272730.pdf

Accelerating science & innovation

Faster translation of new ideas into real-world solutions

Merge the traditional science approach with 'lean startup' thinking

More collaboration, risk taking and entrepreneurship in R&D

Equip students with innovation and entrepreneurship skills & opportunities