



Fertilizing future farming

14th Dahlia Greidinger International Symposium
27 Feb - 1 Mar 2023, Technion, Haifa, Israel

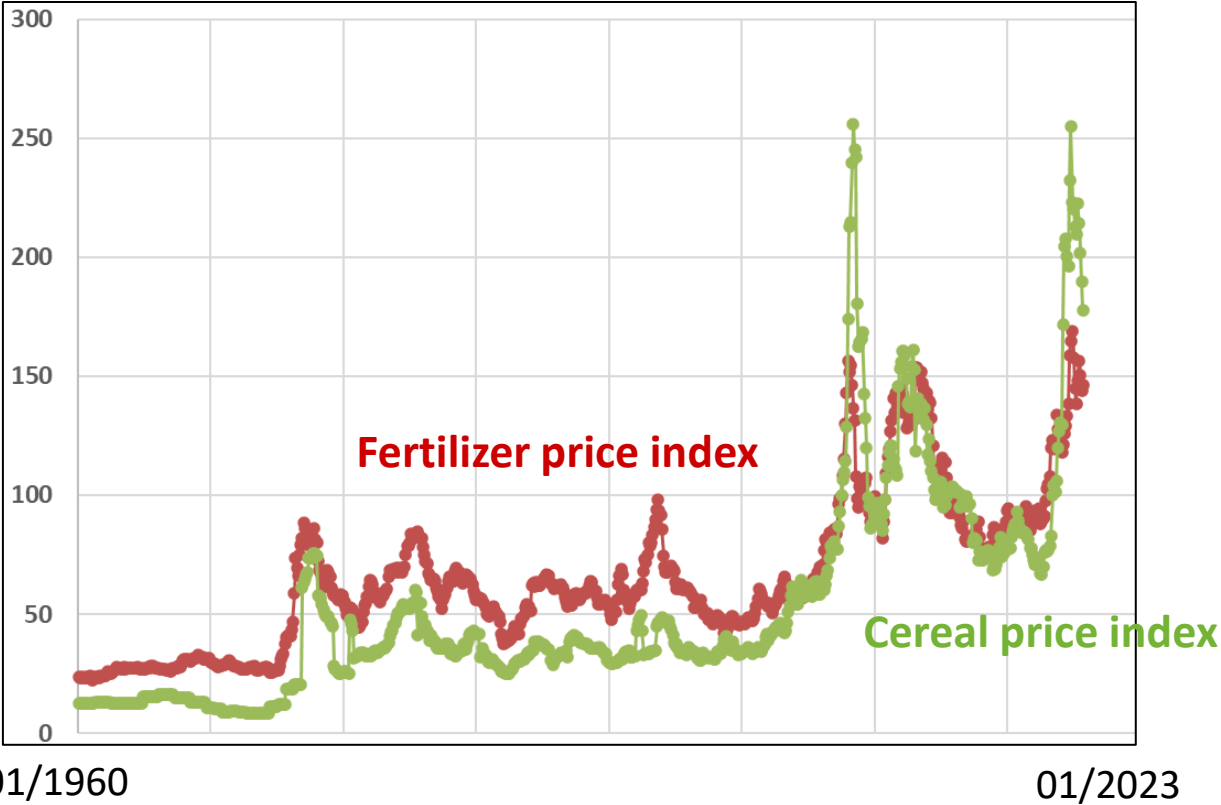
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Chief Scientist

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Fertilizer and food prices are strongly connected



01/1960

01/2023

Fertilizer prices are moving towards the 2021 level

International fertiliser prices have fallen

CRU fertiliser price index (Jan 2006=100)



Source: CRU



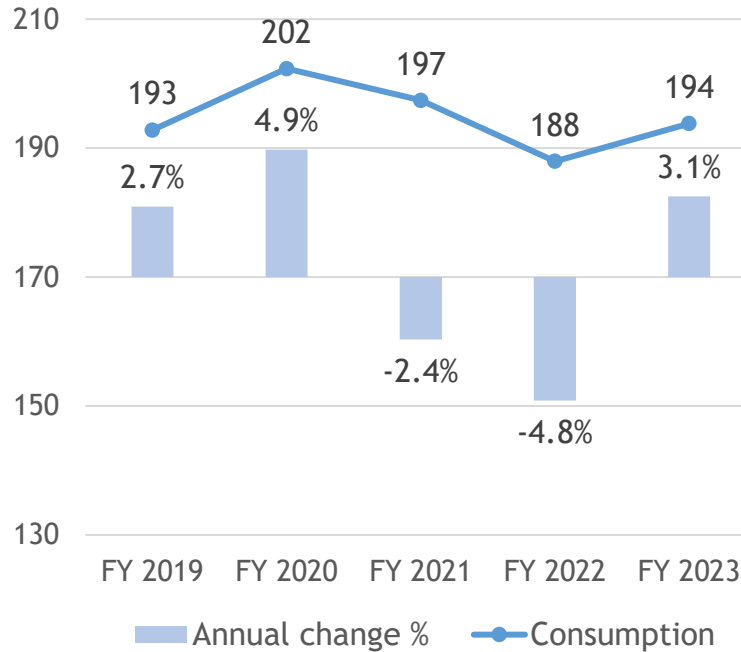
Gas price (Europa)
Export restrictions
Sanctions/war



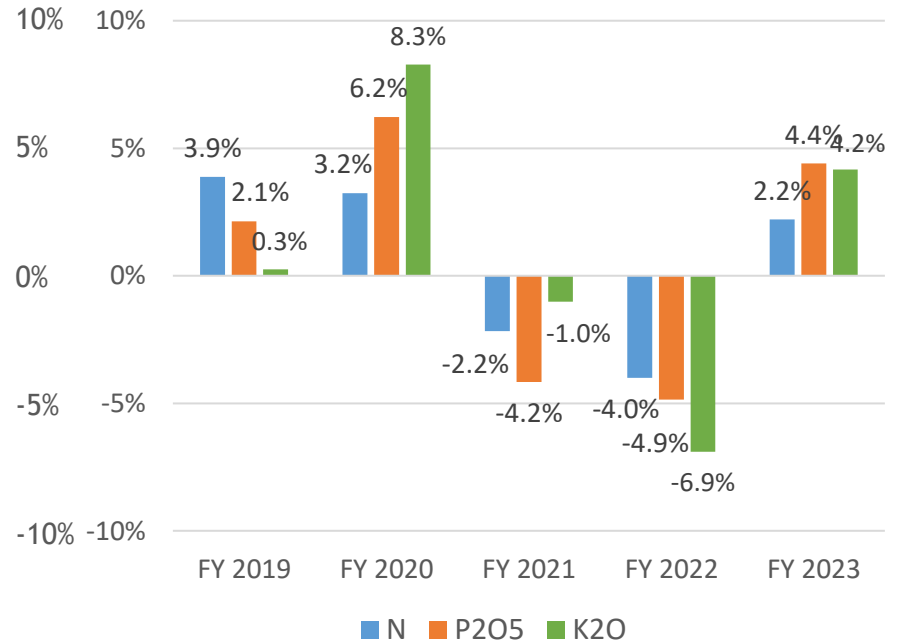
Russian production
Reduced/delayed demand

Short-term: recovery of the global fertilizer market

Global fertilizer consumption
(N + P₂O₅ + K₂O; Millionen t)

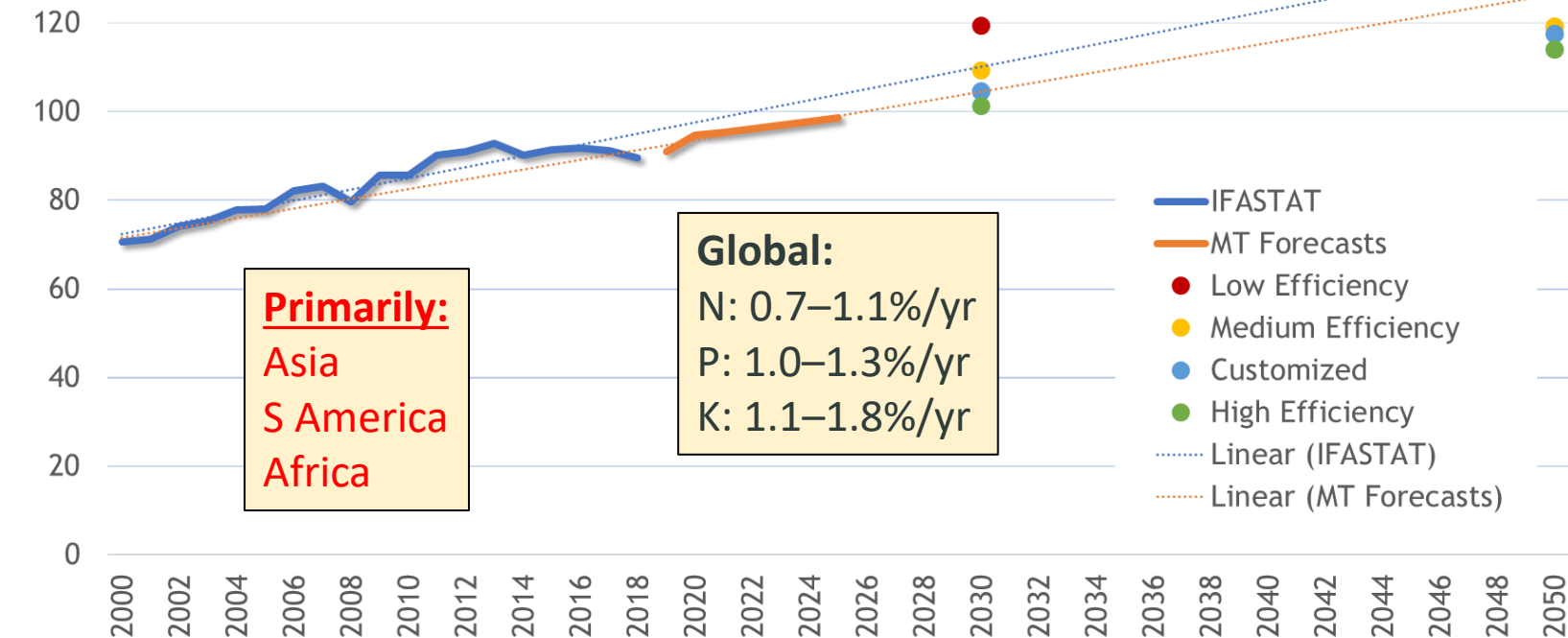


Global fertilizer consumption
(% change)



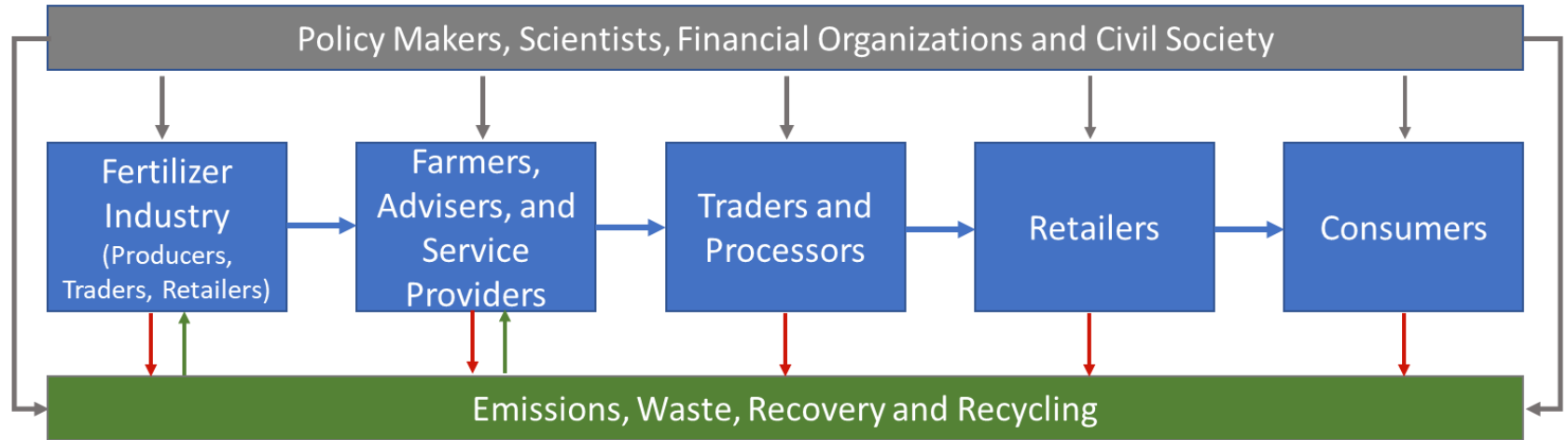
Long-term: ca. 1% annual increase in global demand

N, Mt (Cropland)



IFA projections, 2021

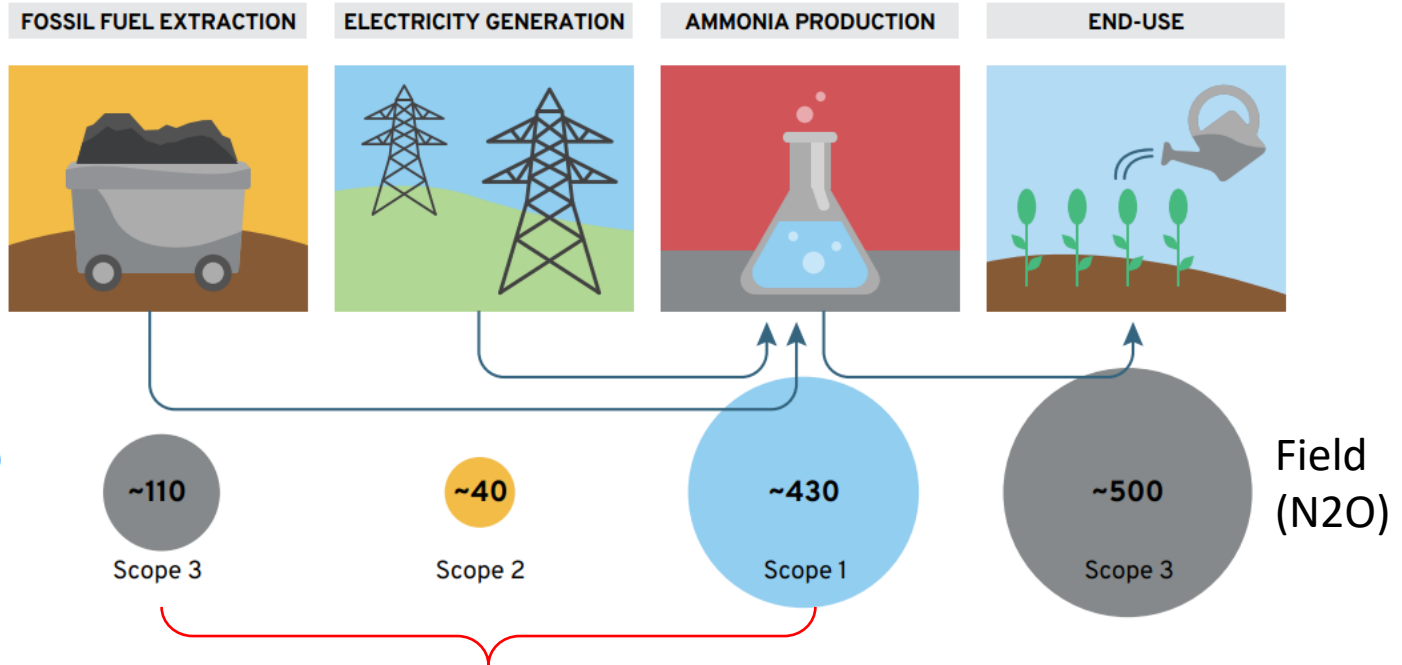
Transforming the food system from a nutrient perspective



Decarbonized fertilizer production
Smart, more diversified fertilizers
More precise crop nutrition advisory
Nutrient recovery & recycling

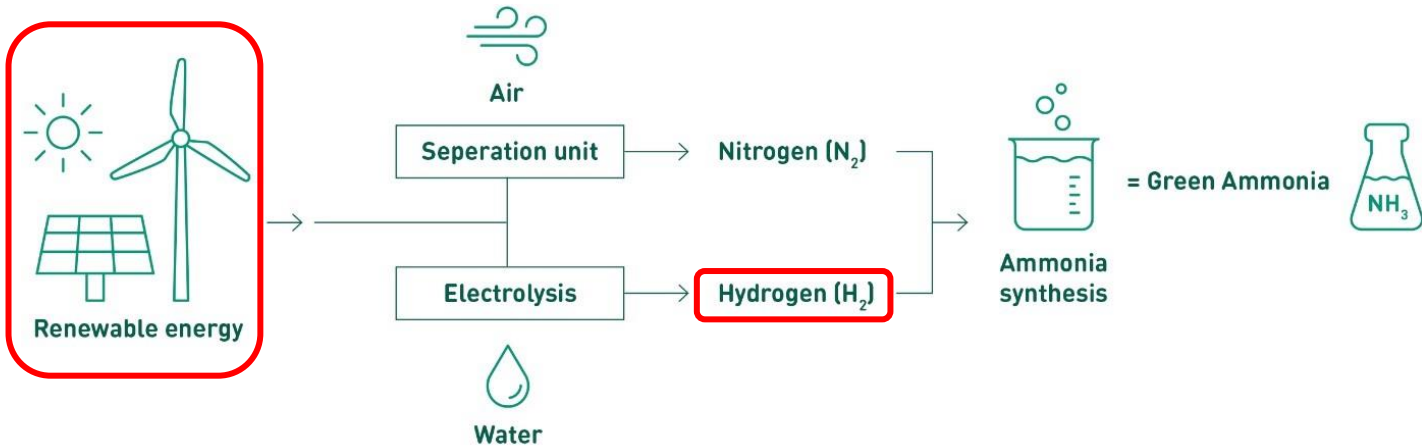
Decarbonizing the ammonia supply chain

Value chain step

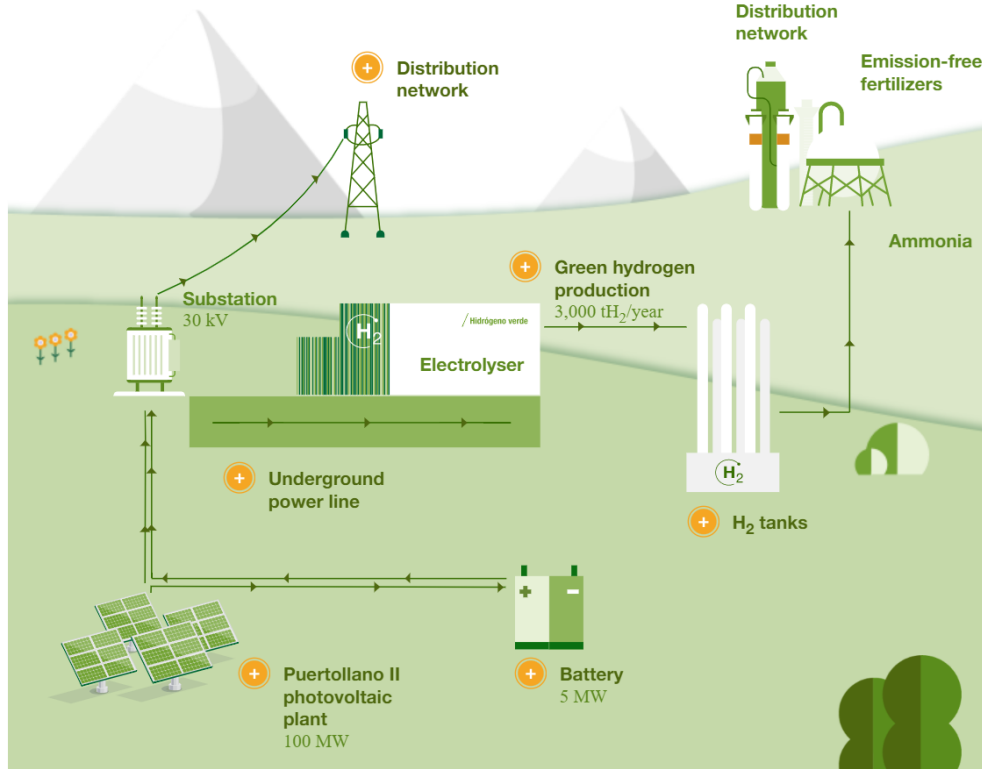


CO₂ emissions from ammonia production represent ~1% of all global emissions. Net zero by 2050: → Blue ammonia → Green ammonia

Green ammonia



Green ammonia



Fertiberia

Investments costs are high: the age of 'cheap' N is probably over

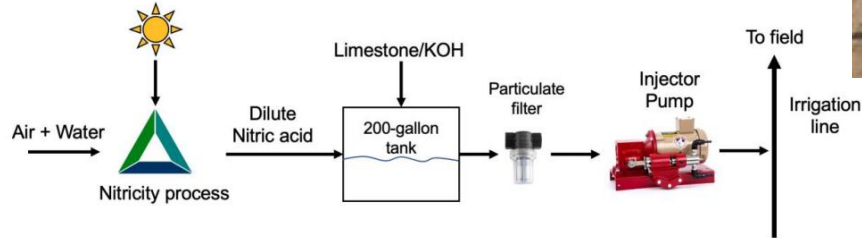
Nitrofix: Container ammonia generator



<https://nitrofixsolutions.com>

150 tonnes ammonia/year
Renewable energy
Simple operation

Nitricity: Nitric acid (HNO_3) generator for fertigation



<https://www.nitricity.co/>

Implications?

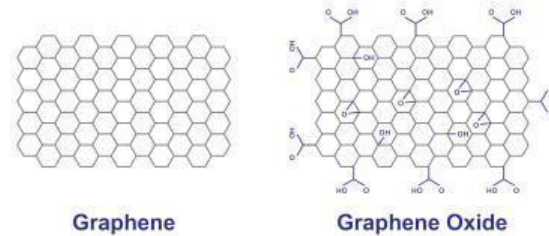
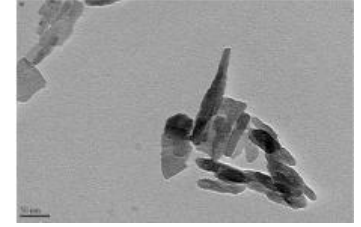
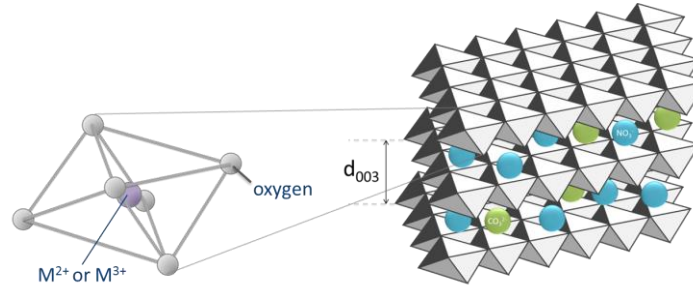
- **More decentralization?**
- **Less urea?**
- **'Green' premiums?**
- **New competition (energy, transport)**
- **More or less market stability?**



Fertiheria, Spanien

Novel fertilizers – the next 10 years

- Nanomaterials
- Layered double hydroxides
- Graphene-based materials
- Hydrogels
- Zeolites
- Stabilised fertilisers (N)
- Sulfur-polymer composites
- Metal-organic frameworks
- Microbiological products
- Biostimulants
- “Smart” products (plant-triggered)

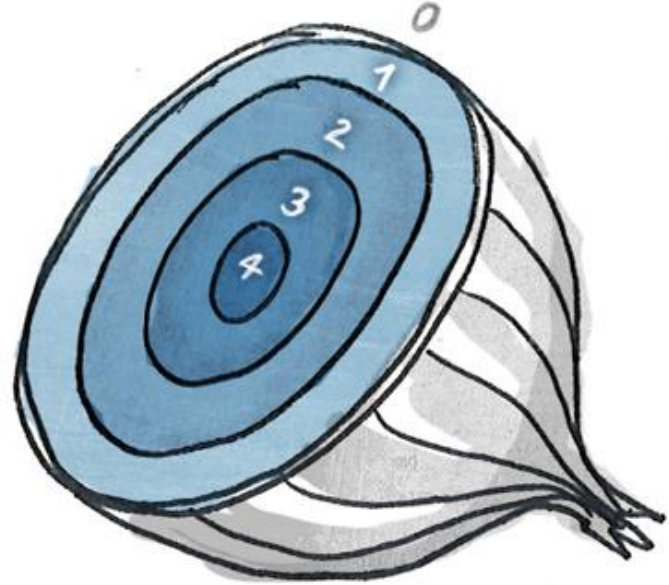


→ More knowledge embedded
→ Rigorous field evaluation is needed

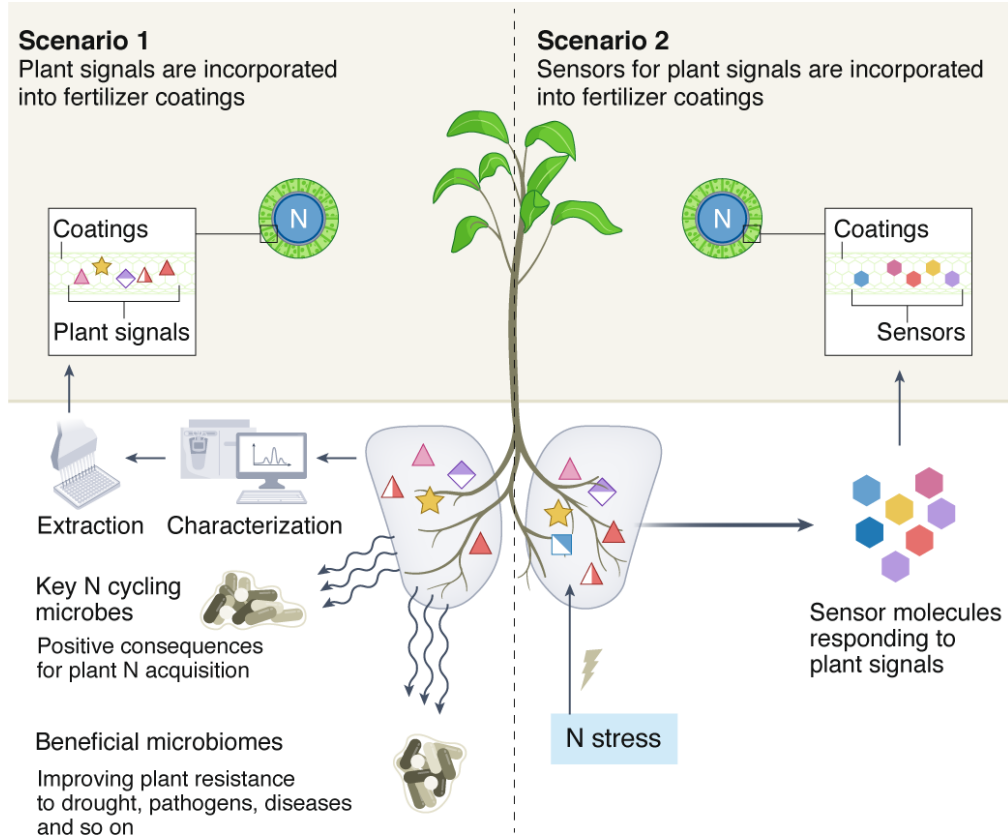
Source: Mike McLaughlin, University of Adelaide

Smart fertilizers

- Tailored in composition, including micronutrients
- Gradual release , triggered by microbes and the plant
- Fully bio-degradable, safe
- Economical in production and use



Plant-oriented coatings?

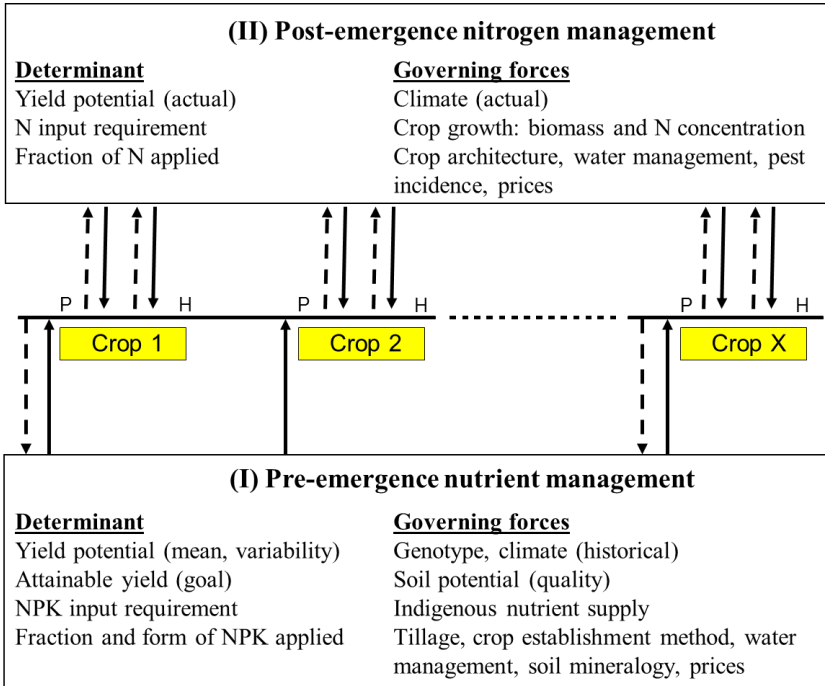


Efficient Fertilizer Consortium

The Efficient Fertilizer Consortium, a public-private partnership, will conduct use-inspired research to advance efficient, environmentally beneficial and cost-effective fertilizers and management practices.



How we currently do fertilizer advisory

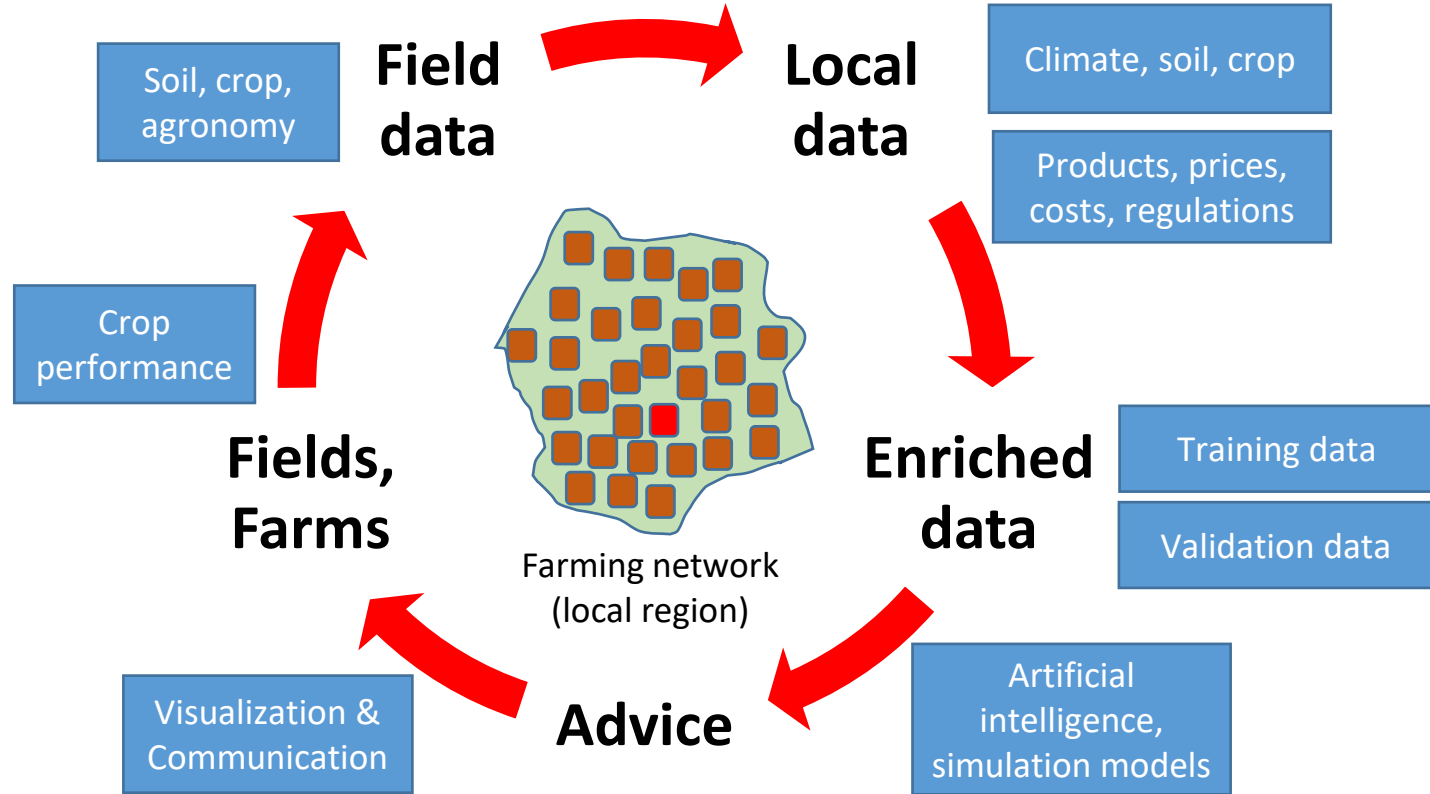


Common limitations:

- Single field, single crop, single nutrient
- Heavy reliance on soil testing → empirical by nature & little progress
- Algorithms/models that do not account for many factors driving response to nutrients (GxExM)
- Fails to factor in uncertainty and communicate risk to farmers
- **Little adoption & performance feedback for systematic learning and local fine-tuning**

Dobermann, A. & Cassman, K.G. 2002. Plant nutrient management for enhanced productivity in intensive grain production systems of the United States and Asia. *Plant Soil* 247: 153-175. (modified)

Data-driven, self-learning crop nutrition advisory



Key requirement: continuous collection, processing and sharing of field data

Methods &
Data

Decision
algorithms,
rules & tools



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CROP NUTRIENT DATA

The Consortium for Precision Crop Nutrition (CPCN) and their member partners have collaborated to form comprehensive databases for researchers and agriculture professionals to access and contribute to global field trial data from soil and crop nutrient concentrations.

[REQUEST ACCESS](#)

WWW.CROPNUTRIENTDATA.NET



<https://www.precisioncropnutrition.net/>

E-mail: cpcn@apni.net



agmatix



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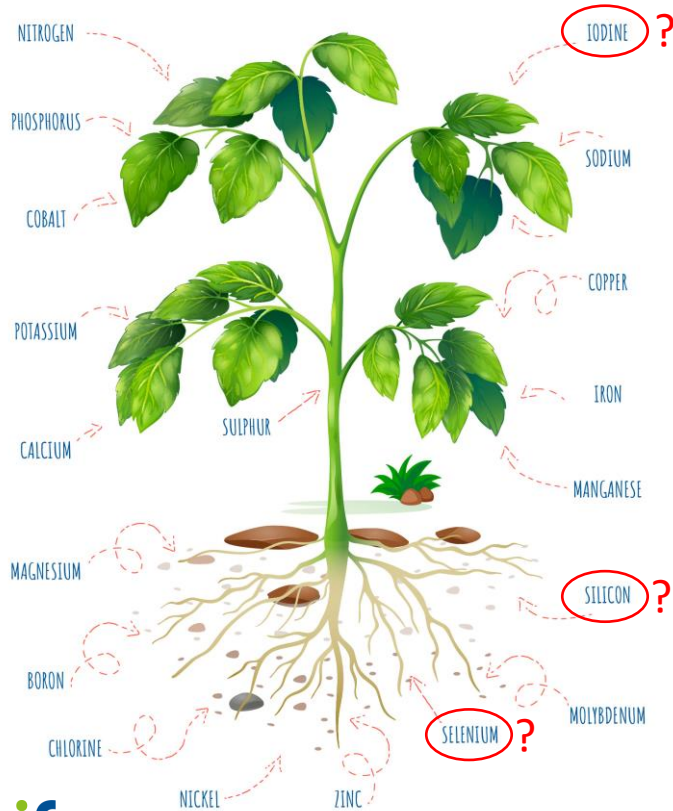
ifa
INTERNATIONAL
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AFRICAN
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NUTRITION
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Rethinking plant nutrients




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



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

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

2020s

- 8 billion people - 100 million t of fertilizer N (crops)
- 'Gray' ammonia
- Bulk fertilizers + empirical crop advice
- Pockets of malnutrition
- Global NUE on cropland ~45%
- Leaky nutrient cycles

2040s

- 9 billion people - 110 million t of fertilizer N (crops)
- 'Green' ammonia
- Smart fertilizers + AI-driven crop advice
- Micronutrient enrichment
- Global NUE on cropland >60%,
- More closed nutrient cycles