A New Paradigm for Plant Nutrition

Scientific Panel for Responsible Plant Nutrition

https://www.sprpn.org/

SCIENTIFIC PANEL
ON RESPONSIBLE PLANT NUTRITION

Scientific Panel on Responsible Plant Nutrition

Vision: *Responsible plant nutrition nourishes plants in a sustainable manner that enhances earth's capacity to support healthy life*

Objectives: *Provide independent science-based knowledge to IFA and other stakeholders involved in food and agriculture on global issues of responsible plant nutrition*

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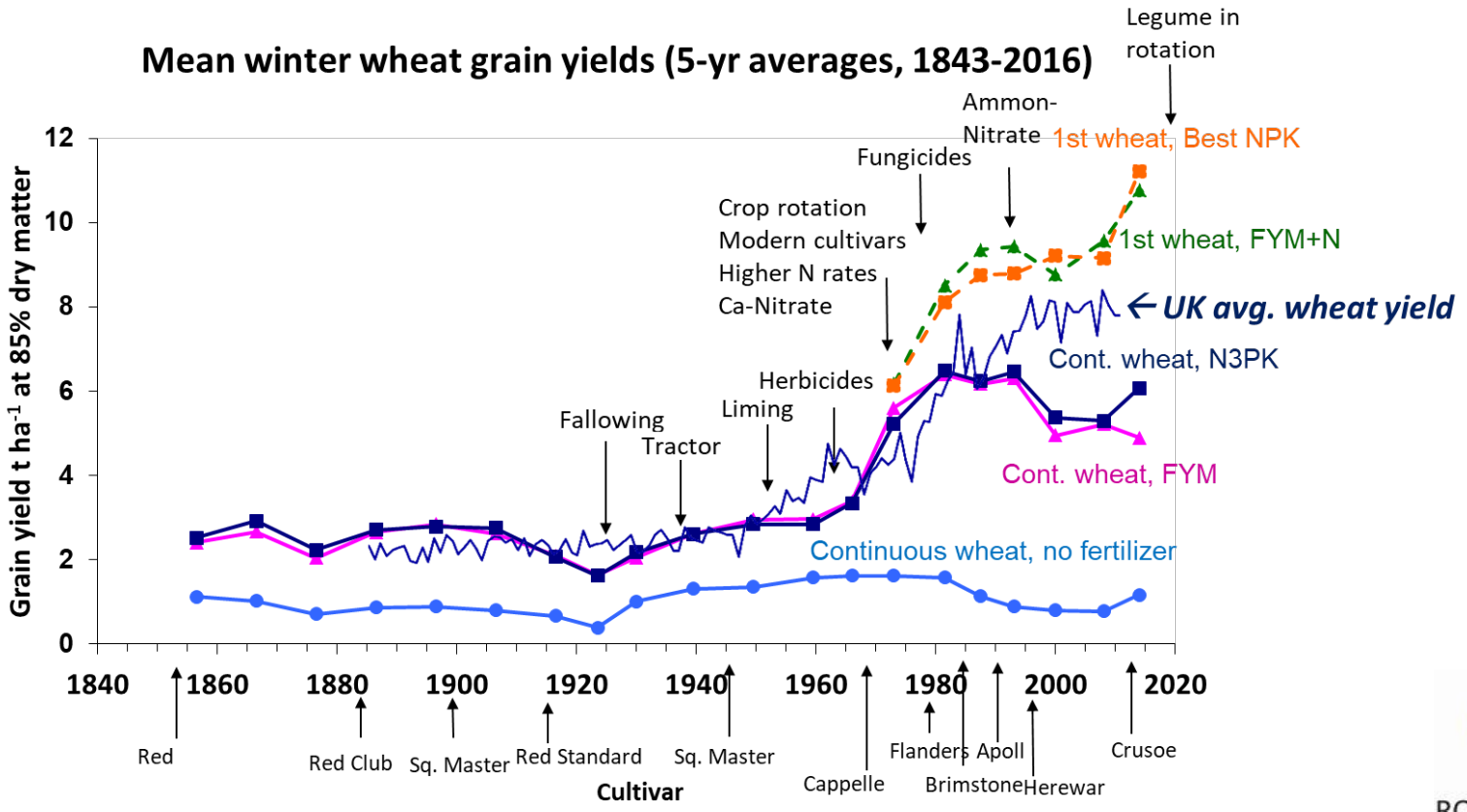
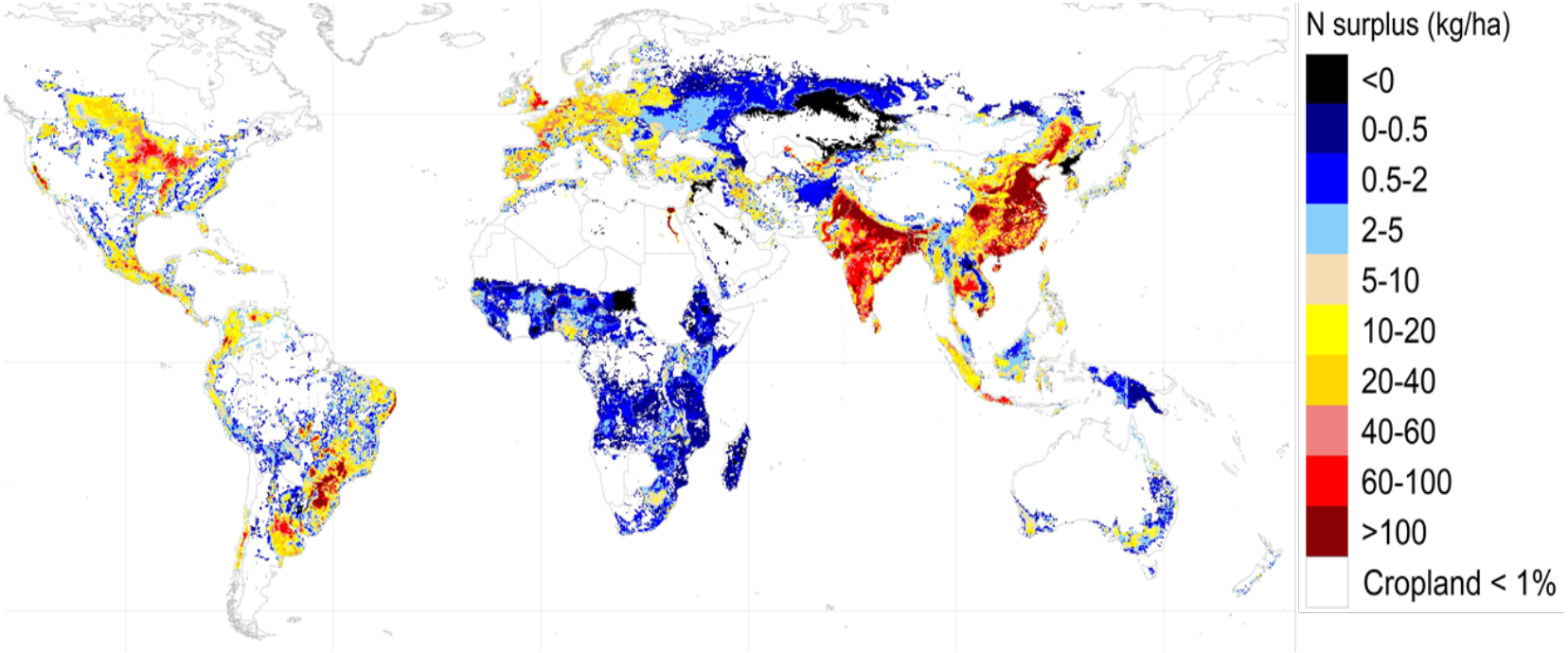
Broadbalk LTE – the story of agriculture



ROTHAMSTED RESEARCH

What is the issue?



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

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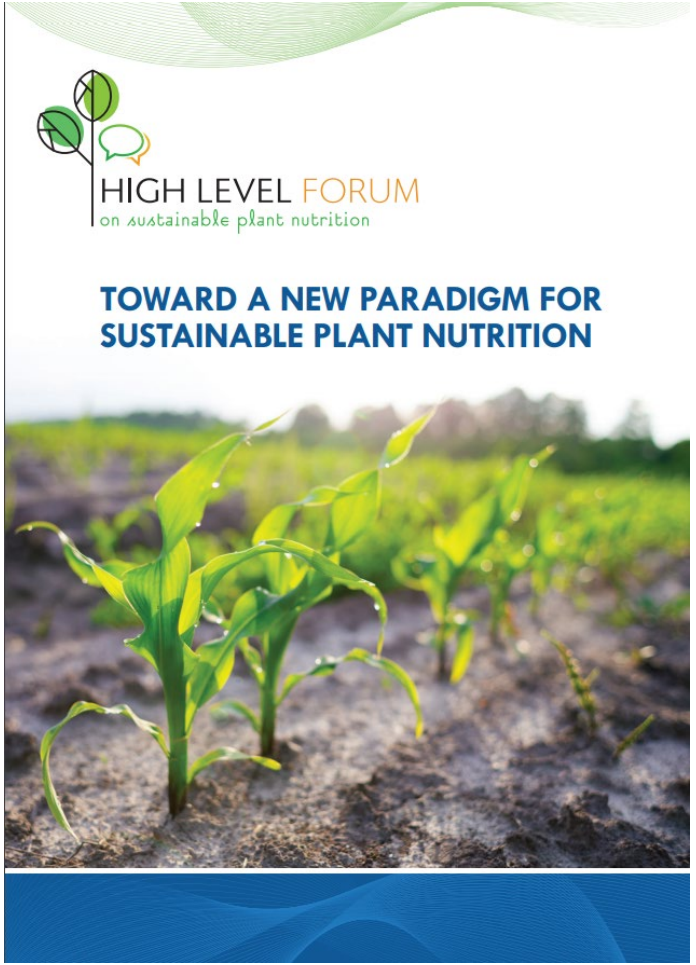
Productivity and food security are still critical needs, but the new paradigm for plant nutrition must embrace a food systems approach with all of its sustainability dimensions, including

- **GHG emission reduction, carbon sequestration**
- **Pollution and biodiversity**
- **Waste and nutrient recycling**
- **Nutrition and health**



ifa INTERNATIONAL FERTILIZER ASSOCIATION

https://www.highlevelforum.org/

November 2019

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A NEW PARADIGM FOR PLANT NUTRITION

Issue Brief, November 2020

What is the issue?
What can be done?
Who needs to do what?
What will success look like?

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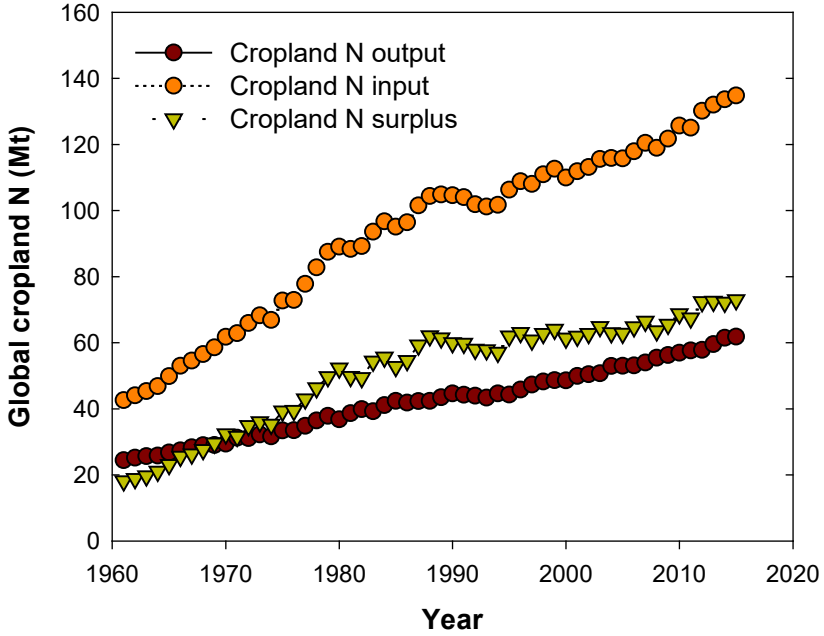
What is the issue?

1 **How can future growth in crop production be decoupled from growth in fertilizer consumption, how can we overcome the global nutrient imbalance?**



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

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

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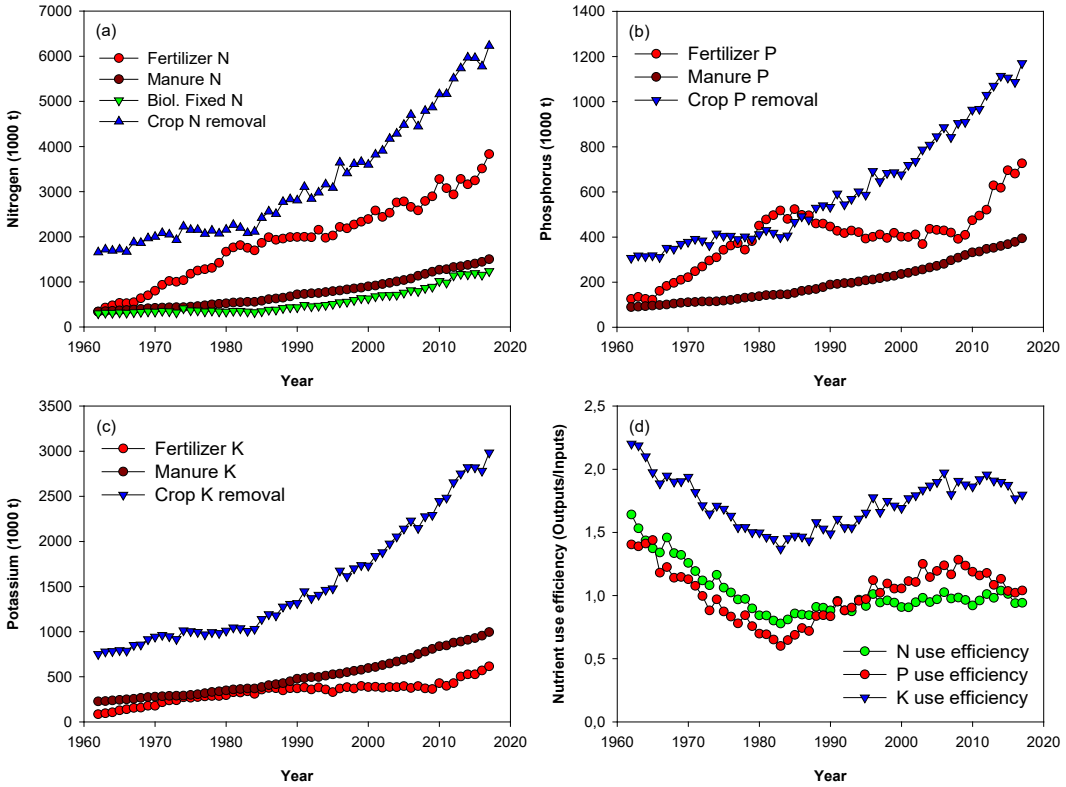
Source: Xin Zhang and Guolin Yao, University of Maryland Center for Environmental Science

What is the issue?



2 **What are the key measures to double or triple crop yields in Africa with increasing and balanced nutrient inputs?**

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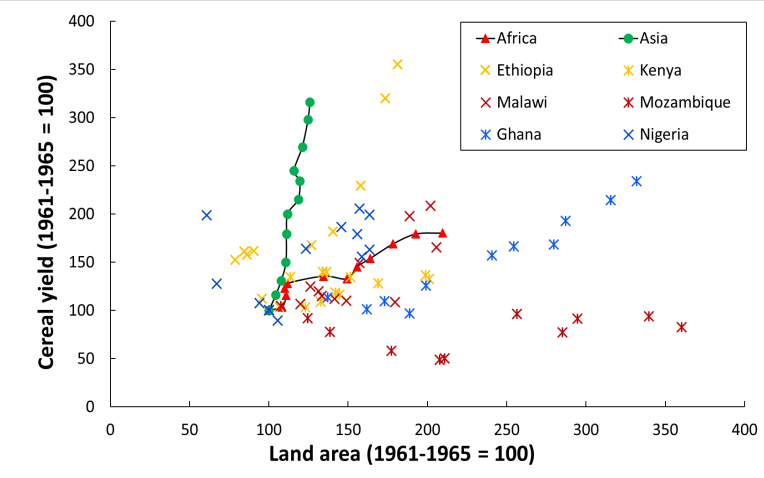
Crop N, P and K removal by far exceeds nutrient inputs from fertilizer, manure and other sources in Africa (1000 tons of N, P and K). Source: IFA Nutrient Use Efficiency database, 1961-2017.

What is the issue?



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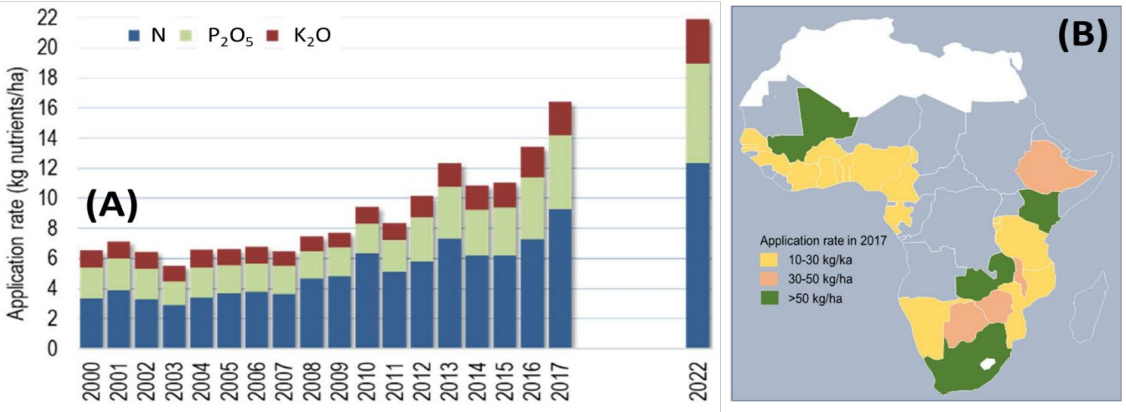

Average rates of fertilizer-nutrient application to cropland in Sub-Saharan Africa (excluding South Africa)

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What is the issue?

3. What data-driven technologies, business solutions and policies will accelerate the adoption of more precise nutrient management solutions by farmers?
4. Can nutrient losses and waste along the whole agri-food chain be halved within one generation?
5. How can nutrient cycles in crop and livestock farming be closed?
6. How can we improve soil health?
7. How should we manage nutrition of crops in changing climates?
8. What are options and targets for reducing fertilizer-related GHG emissions?
9. How can cropping systems deliver high quality, more nutritious food?
10. How can we better monitor nutrients and implement high levels of sustainability stewardship?

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What can be done?

Following a food systems & circular economy approach....

a new paradigm of **responsible plant nutrition** encompasses a broad array of scientific and engineering know-how, agronomic practices, business models and policies that directly or indirectly affect the production, utilization and recycling of mineral nutrients in agri-food systems.

towards developing **integrated, targeted plant nutrition solutions that minimize tradeoffs between productivity, environment and health – and are viable in the farming and business systems of different regions, nations and localities**

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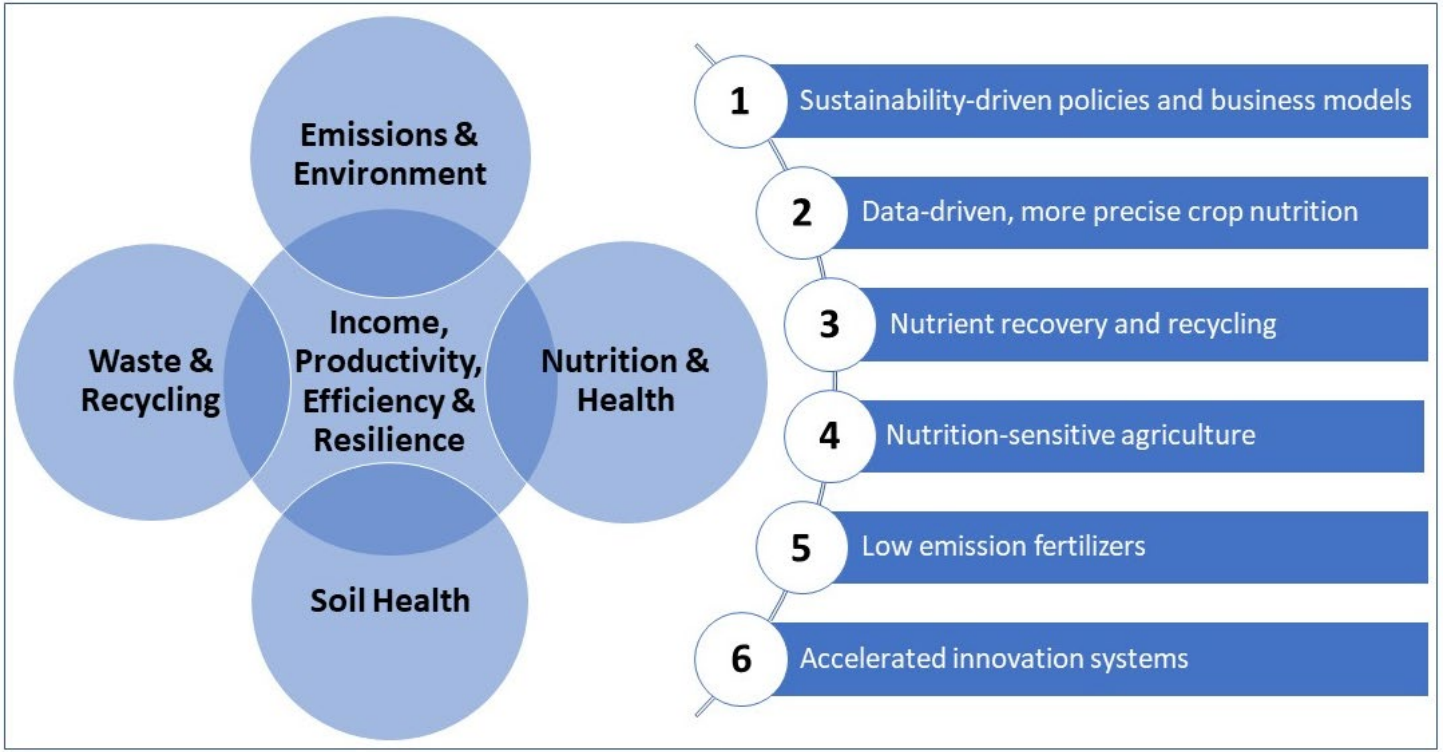
What can be done?

The five interconnected aims of a new paradigm for responsible plant nutrition - and six key actions to take



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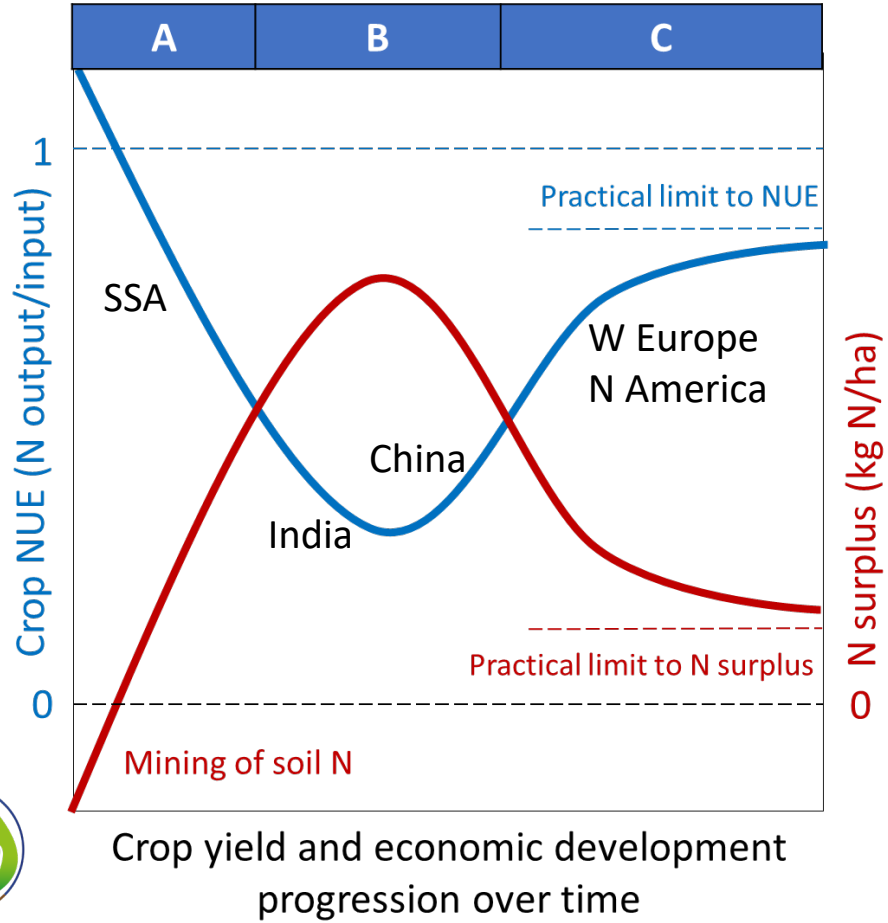
What can be done?



Action 1

Sustainability-driven nutrient policies and business models must be tailored to specific food systems in every country.

Specific targets and priorities for managing nutrients will vary, depending on a country's position along the general nutrient use efficiency pathway.

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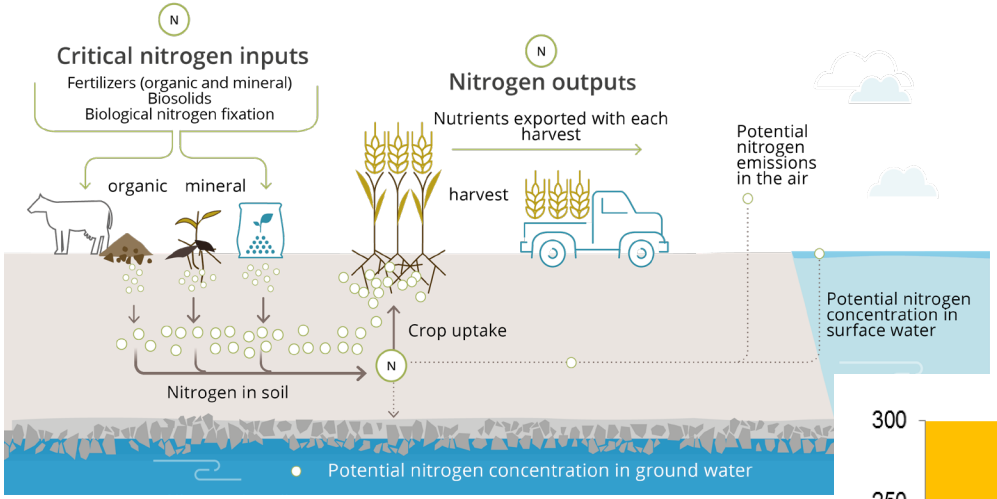
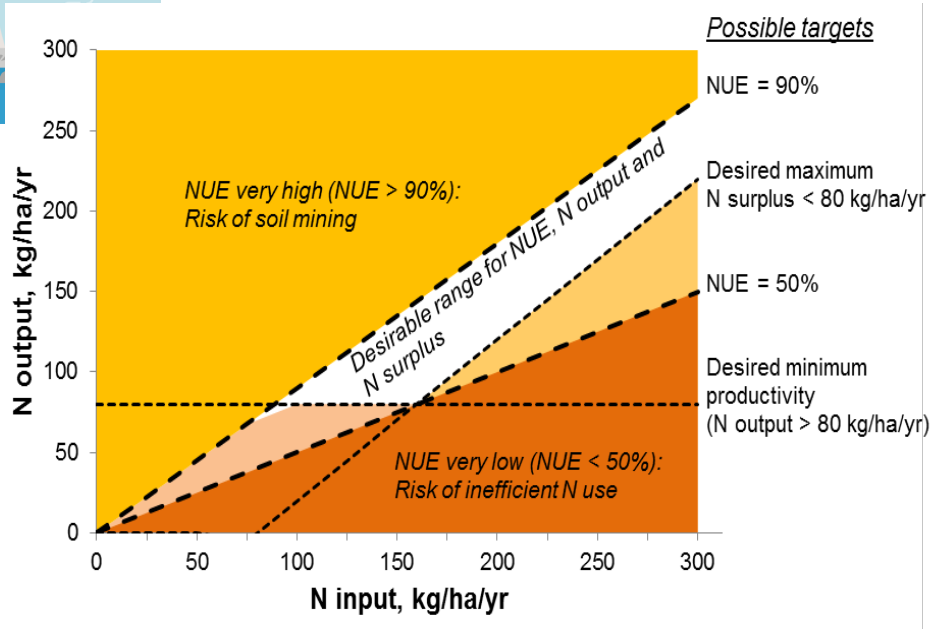
A pragmatic NUE indicator to guide action at farm to national levels





http://www.eunep.com/

EU Nitrogen Expert Panel

What can be done?

Action 2

Knowledge-driven solutions and novel technologies will allow tailoring nutrient formulations and applications to local needs in an increasingly precise manner.

They need to be upscaled to millions of farmers through digitally supported advisory systems and integrated business solutions.

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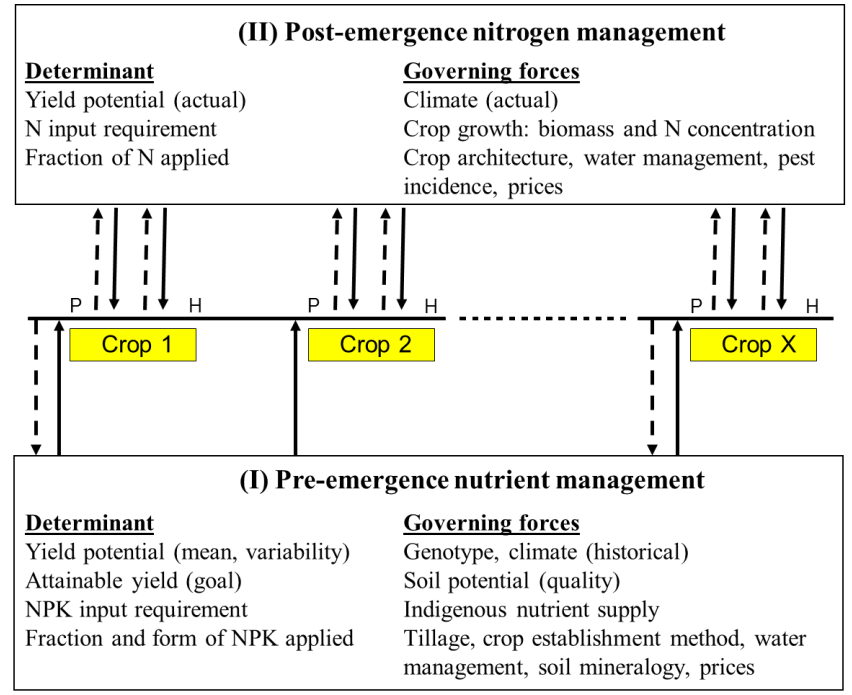
Site-specific nutrient management for smallholder farmers

Performance in rice, wheat & maize:

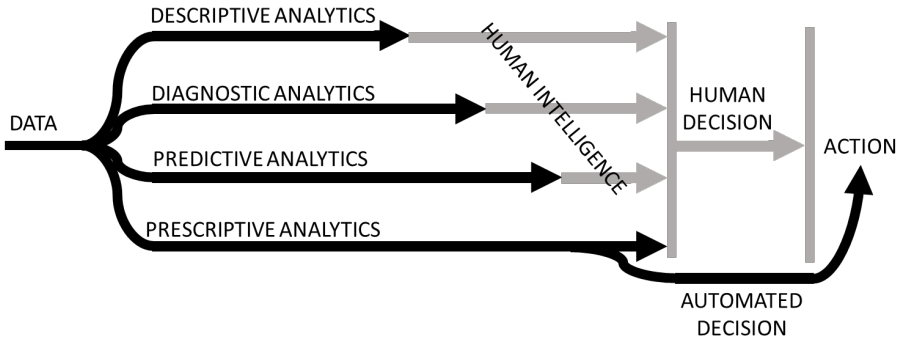
10-20% more yield & profit
10% less N
30-50% higher fertilizer NUE
Less GHG emissions & water pollution
Less soil nutrient mining
Less pests & diseases

NUTRIENT EXPERT®



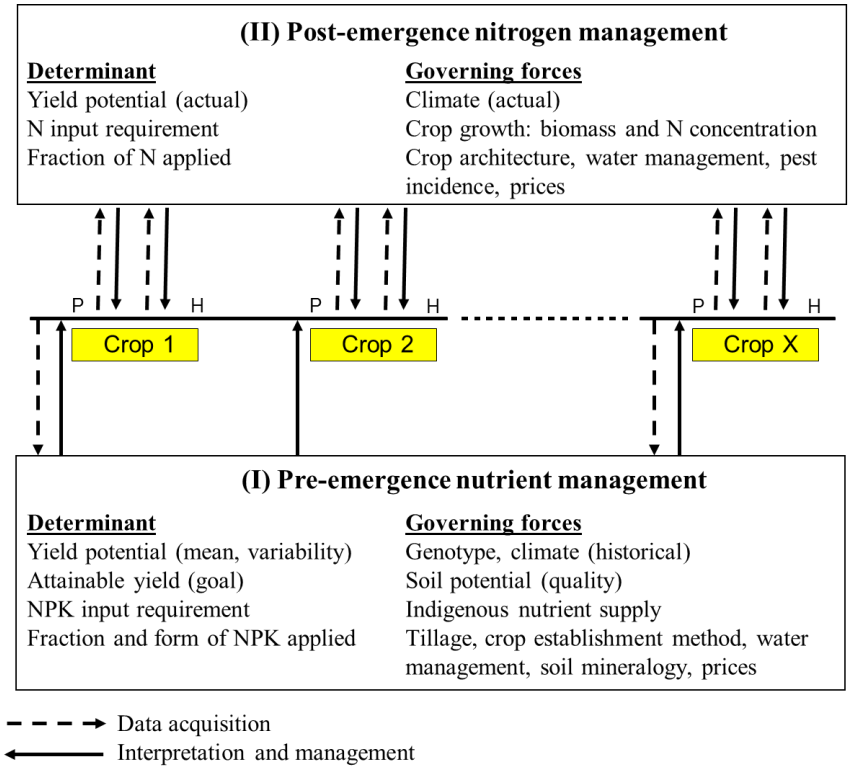
Dobermann, A. & Cassman, K.G. 2002. Plant nutrient management for enhanced productivity in intensive grain production systems of the United States and Asia. Plant Soil 247: 153-175. (modified)

Data- and AI-driven site-specific nutrient management?



Matthew Smith, Agrimetrics, UK
Getting value from artificial intelligence in agriculture. *Animal Production Science* (2018), https://doi.org/10.1071/AN18522

Self-learning fertilizer recommendations + real-time guidance throughout the life cycle of a crop, and for whole cropping systems?



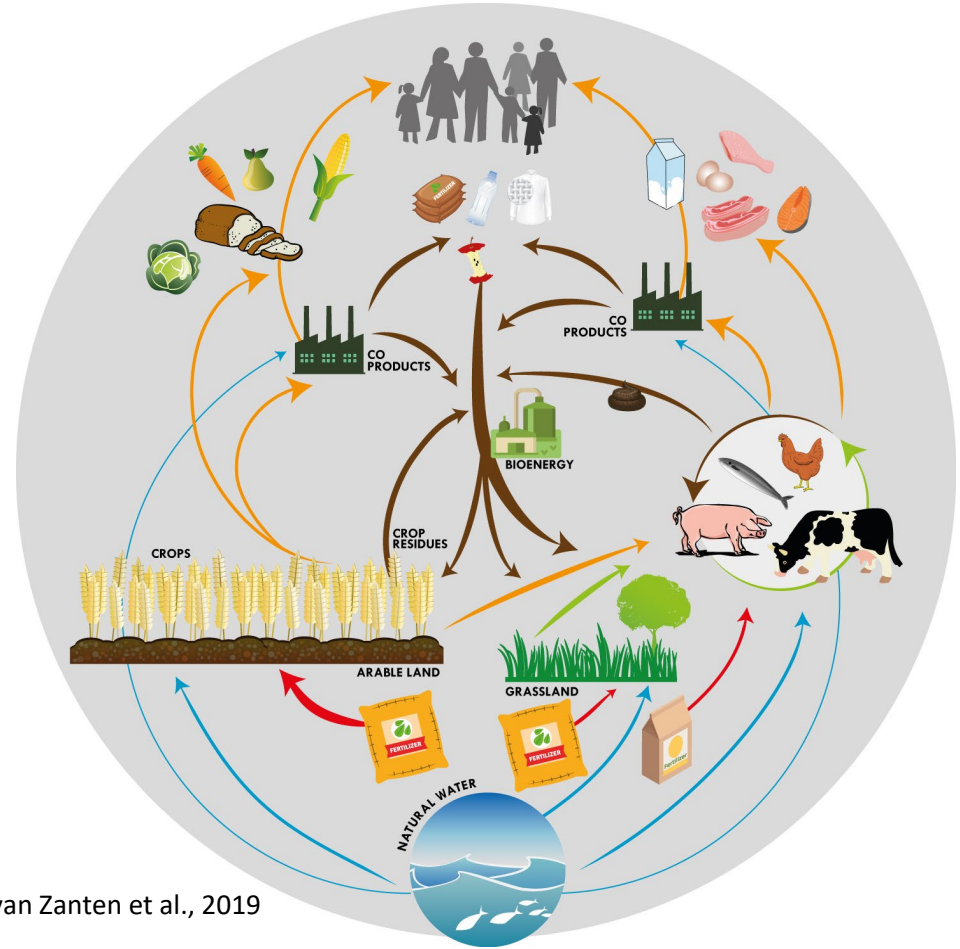
Dobermann, A. & Cassman, K.G. 2002. Plant nutrient management for enhanced productivity in intensive grain production systems of the United States and Asia. Plant Soil 247: 153-175. (modified)

What can be done?

Action 3

Crop-livestock integration, less food waste, by-products use and increased nutrient recycling are key measures to optimize nutrient use efficiency across the full food chain.

Political incentives, novel technologies and shifts in behavior will drive greater nutrient recovery from multiple waste streams, as part of circular, bio-based economies.



Re-drawn and modified from van Zanten et al., 2019

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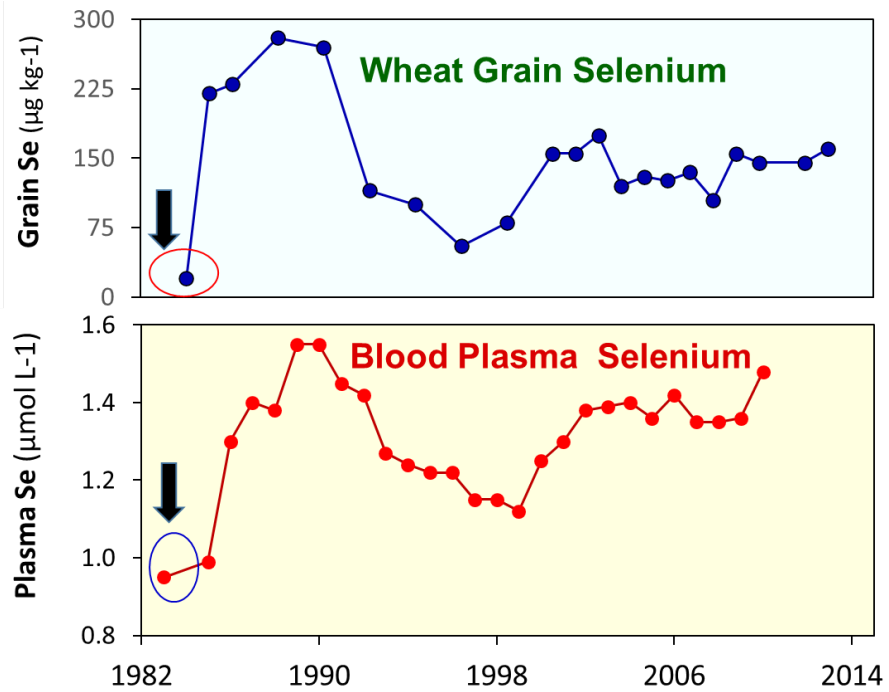
What can be done?

Action 4

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



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

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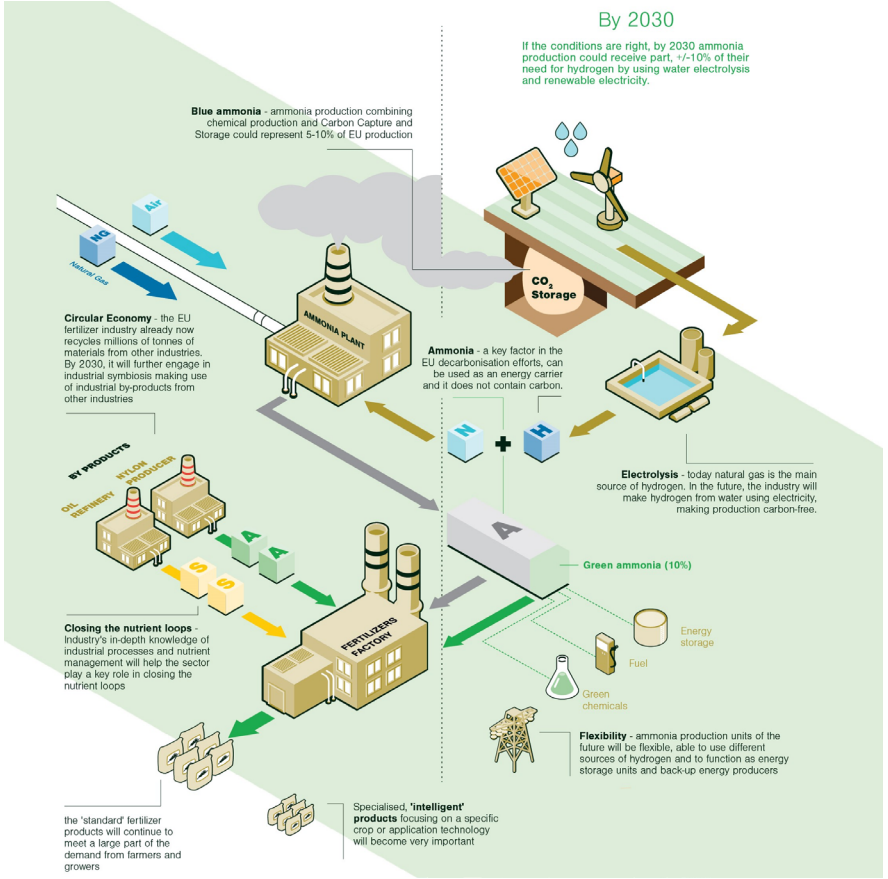
What can be done?

Action 5

Fertilizers will increasingly be produced in an environmentally friendly manner and they will embody greater amounts of knowledge to control the release of nutrients to the plant.

A new “green ammonia economy” could feed and power the world in a whole new, decentralized manner.



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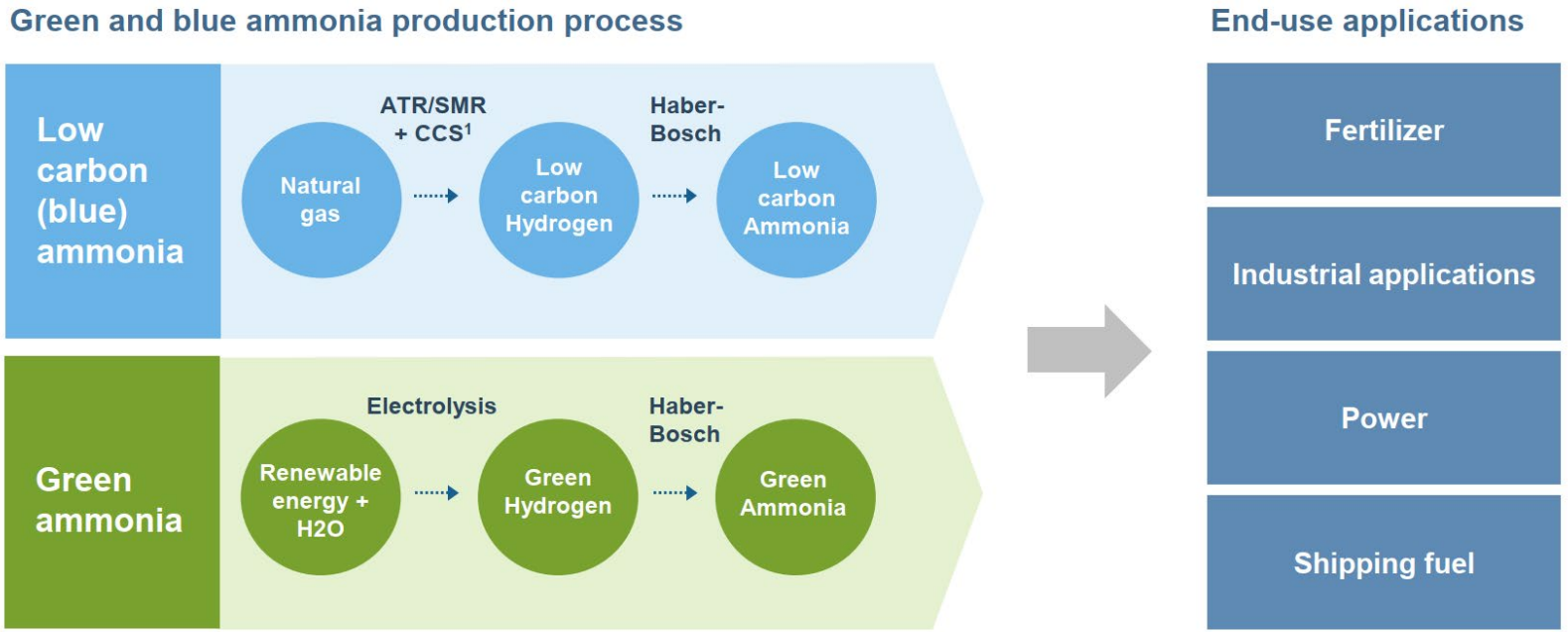
Fertilizers Europe

Both blue and green ammonia facilitate decarbonization



https://www.yara.com/investor-relations/esg-investor-seminar/

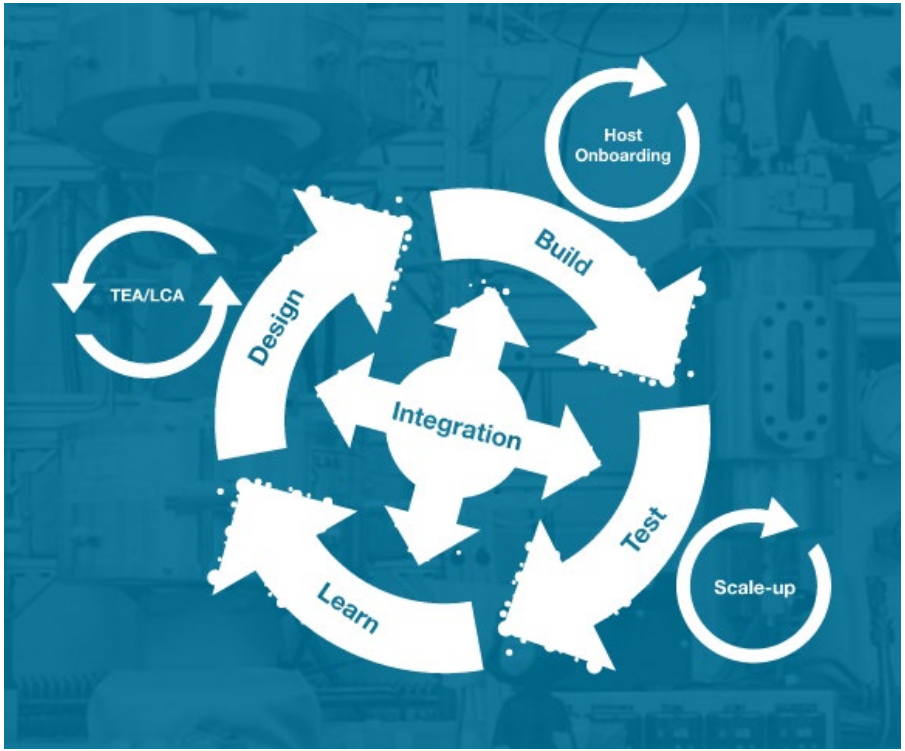
1) ATR: Autothermal Reforming, SMR: Steam Methane Reforming, CCS: Carbon Capture and Storage

What can be done?

Action 6

Accelerated, more open innovation systems for faster translation of new ideas into practice.

This requires more investment, collaboration, risk taking and entrepreneurship by industry, but also a massive culture change in science and science funding.



https://agilebiofoundry.org/

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Science and innovation

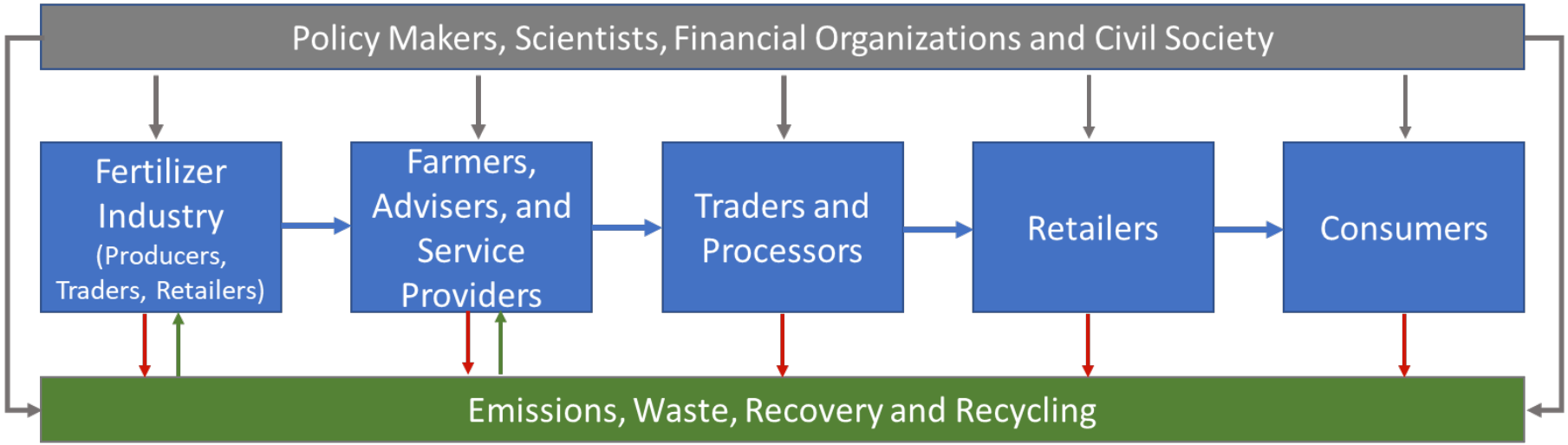
Science is about discovery, ideas generation and building knowledge

Invention is about making something no-one has made before

Innovation is the process by which ideas, previous knowledge and inventions are converted into commercially viable products. This requires that they can be translated into practice at scale and their continued use is supported by a viable business model.

→ **Common: Excellent science – Poor innovation**

Who needs to do what?



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What will success look like?

A **societal plant nutrition optimum.**

by 2040:

1. Accepted standards and roadmaps for nutrients along the whole chain.
2. Crop yield growth outpaces growth in fertilizer; crop NUE ↑ to 70%.
3. Nutrient waste halved to reduce harm; no more hotspots.
4. In sub-Saharan Africa, fertilizer use has tripled.
5. Extreme forms of hunger and malnutrition gone.
6. Fertilizer GHG footprint reduced by 30%.
7. Investments in research & innovation triple.
8. Consumers appreciate fertilizer's role and footprint.
9. All farmers access tailored plant nutrition solutions.

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Download the issue brief at :
https://www.sprpn.org/issue-briefs

For more information, please contact:

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