HIGH LEVEL FORUM
on sustainable plant nutrition

18-19 NOVEMBER 2019

Accelerating Science and Innovation for Responsible Plant Nutrition

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ROTHAMSTED RESEARCH

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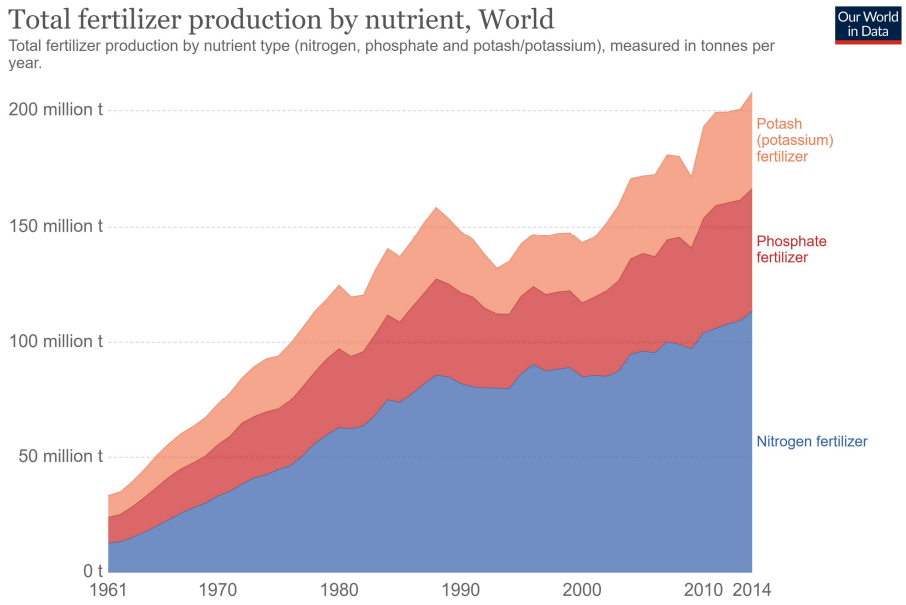
Total fertilizer production by nutrient, World
Total fertilizer production by nutrient type (nitrogen, phosphate and potash/potassium), measured in tonnes per year.
Our World in Data
200 million t
150 million t
100 million t
50 million t
0 t
1961
1970
1980
1990
2000
2010
2014
Potash (potassium) fertilizer
Phosphate fertilizer
Nitrogen fertilizer
Source: UN Food and Agricultural Organization (FAO)
OurWorldInData.org/fertilizer-and-pesticides/ • CC BY

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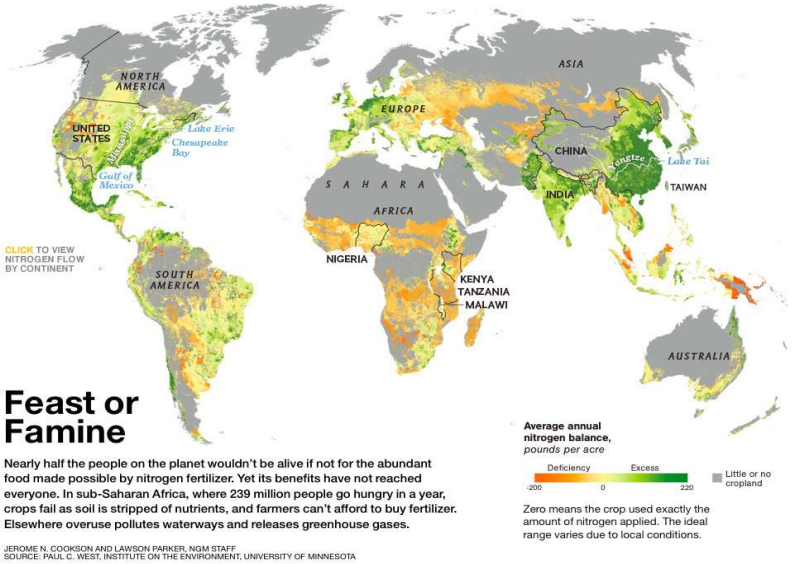
Global nutrient imbalance
NORTH AMERICA
UNITED STATES
Lake Erie
Chesapeake Bay
Mississippi
Gulf of Mexico
SOUTH AMERICA
EUROPE
S A H A R A
AFRICA
NIGERIA
KENYA
TANZANIA
MALAWI
ASIA
CHINA
Yangtze
Lake Tai
TAIWAN
INDIA
AUSTRALIA
CLICK TO VIEW NITROGEN FLOW BY CONTINENT
Feast or Famine
Nearly half the people on the planet wouldn't be alive if not for the abundant food made possible by nitrogen fertilizer. Yet its benefits have not reached everyone. In sub-Saharan Africa, where 239 million people go hungry in a year, crops fail as soil is stripped of nutrients, and farmers can't afford to buy fertilizer. Elsewhere overuse pollutes waterways and releases greenhouse gases.
JEROME N. COOKSON AND LAWSON PARKER, NGM STAFF
SOURCE: PAUL C. WEST, INSTITUTE ON THE ENVIRONMENT, UNIVERSITY OF MINNESOTA
Average annual nitrogen balance, pounds per acre
Deficiency
Excess
-200
0
220
Little or no cropland
Zero means the crop used exactly the amount of nitrogen applied. The ideal range varies due to local conditions.

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At global scale, we will need to decouple future growth in agricultural production from growth in fertilizer consumption

IFA 2030 Scenarios

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Since 1990s Towards more precise nutrient management

- Crop breeding for higher NUE (little success); biofortification
- Wide range of NM recommendations; more emphasis on crop
- Precision farming technology (VRT, sensors, models)
- SSNM, ISFM guidelines and tools for smallholder farming
- Digital soil mapping
- Numerous new soil & plant diagnostic tools
- Diverse fertilizer products offered by the industry
- Increasing investment in fertilizer use in Africa
- Nutrient regulation & stewardship (Environ. concerns)
- Digital extension tools
- More recently: disruptive technologies, new entrepreneurs

→ Overall investment in R&D has remained low and fragmented (public sector and industry)
→ Poor adoption of many innovations

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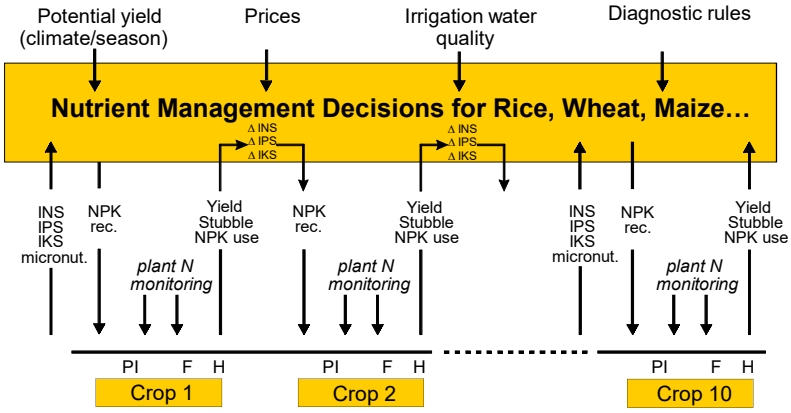
Site-Specific Nutrient Management for smallholder farmers



- **Rice Crop Manager** Apps (Bangladesh, India, Philippines, Indonesia, Vietnam, China)
- **Nutrient Expert** Apps for rice, wheat, maize, soybean and cassava in 20 countries across Asia and Africa

1994-2019 (10 years research + 15 years digital application)

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SSNM performance in smallholder farms in Asia and Africa (rice, wheat, maize)

At least 10-20% more yield and profit

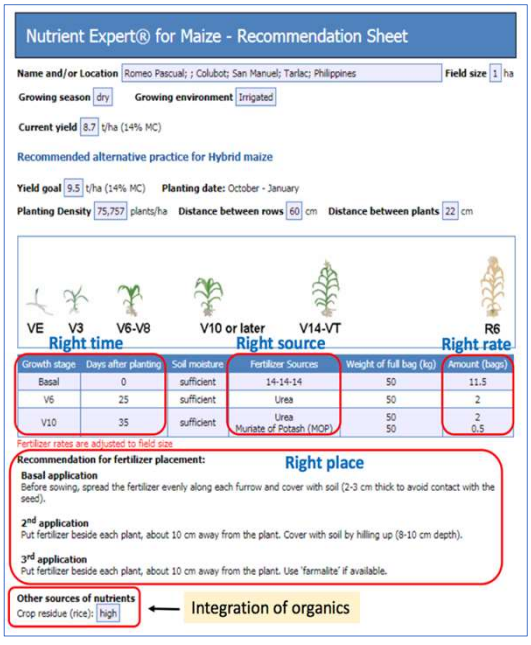
30-50% higher agronomic NUE

- Less GHG emissions
- Less water and air pollution

More balanced nutrition

- Less soil mining
- Less insect pests and diseases

→ Reached hundreds of thousands farmers, not millions
→ Limited uptake by industry



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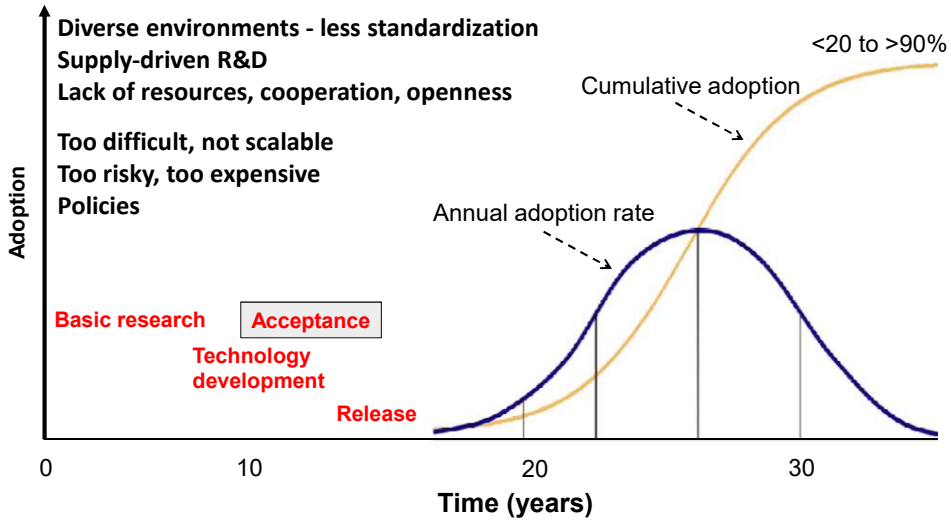
Why so slow and often unsuccessful?



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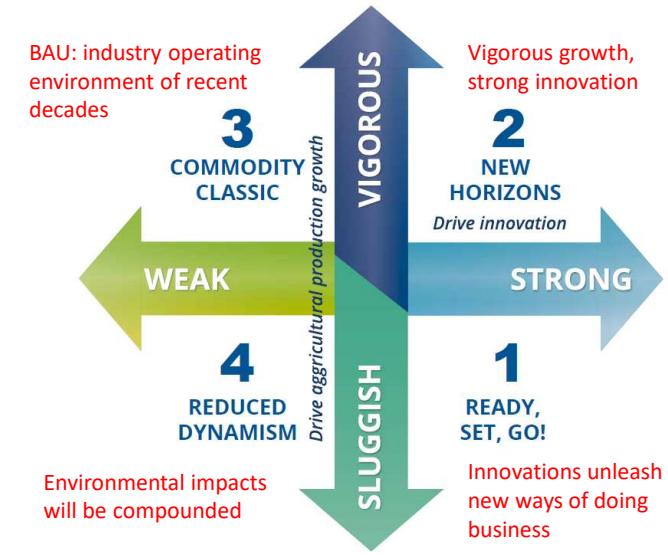

IFA 2030 Scenarios

New business model:

Innovative **crop nutrition companies** that offer tailored solutions with massive knowledge embedded, including new production technologies and more recycling.

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Industry interests and innovation drivers

- Operational efficiency (plant processes, logistics)
- Formulations and blends, including secondary and micronutrients
- Inhibitors (new molecules & formulations)
- Smart fertilizers (controlled release)
- Biodegradable polymers
- Nanofertilizers
- Biostimulants/biofertilizers
- Customer orientation & customization
- Digital technologies
- ……

IFA 2030 Scenarios

→ How to connect this better with publicly funded research?

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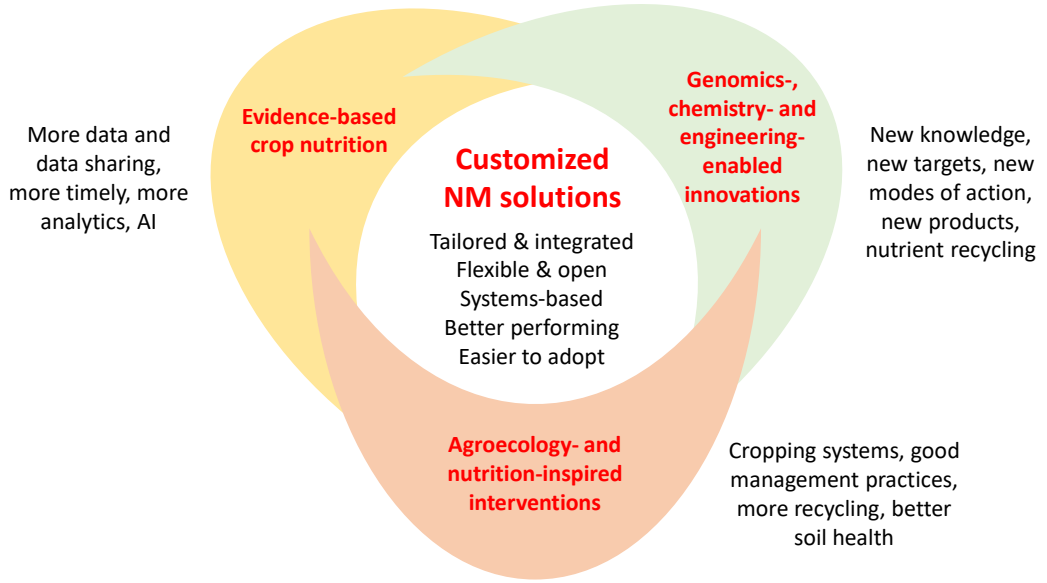

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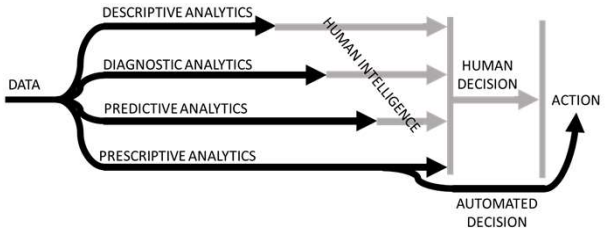
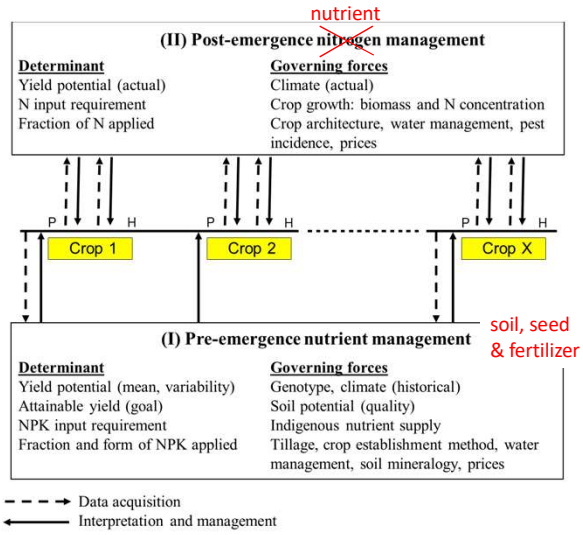
Data- and AI-driven nutrient management decisions



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



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)

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What's Possible

A broad range of applications, a multitude of industries.

"Personalized" NM, but who will develop, share and validate application algorithms?

NeoSpectra-Scanner

Portable and handheld spectral sensing scanner.

Above the Scanner
- o Set the scanner on a flat surface
- o Place samples on top

Point & Shoot
- o Hold scanner in hand
- o Point and shoot at samples

Below the Scanner
- o Place samples on a flat surface
- o Set the scanner on top

https://www.neospectra.com/

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Common standards and tools for responsible NM

Uncle Ben's

MARS: 100% rice sourced from farmers working with SRP standards by 2020.

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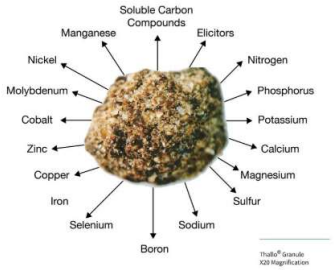
From grass to grass: turning abattoir waste into fertilizer

Elemental Digest - Thallo Impact Lab
from Elemental Digest Systems

THALLO
SUSTAINABLE
ORGANO-MINERAL FERTILISER



https://elementaldigest.com/

Small fertilizer factories that supplement the big supply chains and help us increase the full-chain nutrient use efficiency

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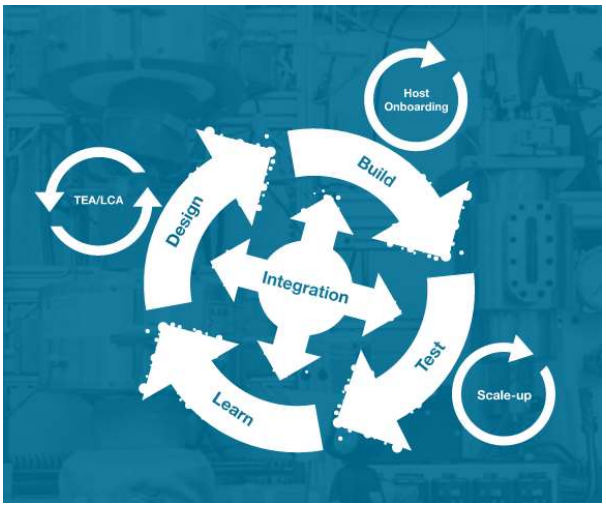
Open innovation to engage, co-develop and scale up faster



https://agilebiofoundry.org/

- Build a prototype to test
- Test your riskiest assumptions quickly
- Learn and design, then test again
- Fail quickly; pivot; rebuild
- Scale up

Desirability
Usefulness
Viability
Feasibility

Teams of biological scientists, computational scientists, chemists and engineers

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Vision & Strategy

DIGITAL SERVICES ALREADY EXIST – WE ENVISION A WORLD WHERE SMALLHOLDER FARMERS HAVE SEAMLESS ACCESS TO THESE SERVICES

Planning | Pre-Planting | Planting | In Season | Management | Harvesting | Post Harvest & Market

Plan the season
using market information, livestock prices, soil health, seed performance and climate predictions from a tablet

Purchase Seeds and Fertilizer
via mobile money using a bundled loan secured with transactional history and climate risk for those seeds

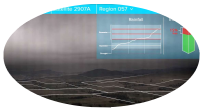
Adjust to the Weather
Check weather forecast on a phone and delay planting to avoid loss due to lack of rainfall

Apply Correct Treatment
Receive advice from a smart phone app on the proper medication for sick livestock

Insurance or Subsidy
Receive a mobile money insurance payment for lost crop due to heavy rainfall through in the latter part of the season

Order a Tractor Service
Use a digital service to order and schedule a walk behind tractor for plot preparation

Learn New Techniques
Watch and discusses a video demonstration of plant spacing at a community meeting



Receive a Disease Alert
Based on a disease risk SMS from the national surveillance system procure and apply a fungicide to protect the crop

Timely Agronomic Advisory
Use data driven agronomic advisory to apply the right amount and blend of fertilizer at the right time

Digital Market Access
Take products to a market slightly further away because of a better price secured through a digital marketplace

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Vision & Strategy

DIGITAL SERVICES AND AG-TECH EXAMPLES (INDIA)

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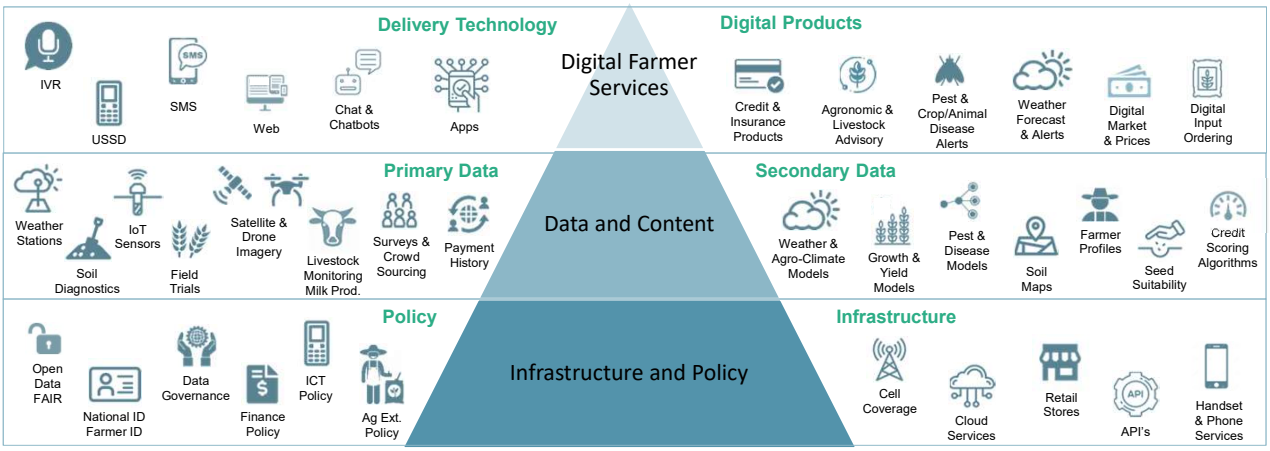
Vision & Strategy

DIGITAL PLATFORMS AND AG-DATA ECOSYSTEM POWERING DIGITAL AGRICULTURE



→ Humans are involved in every layer, every component of this

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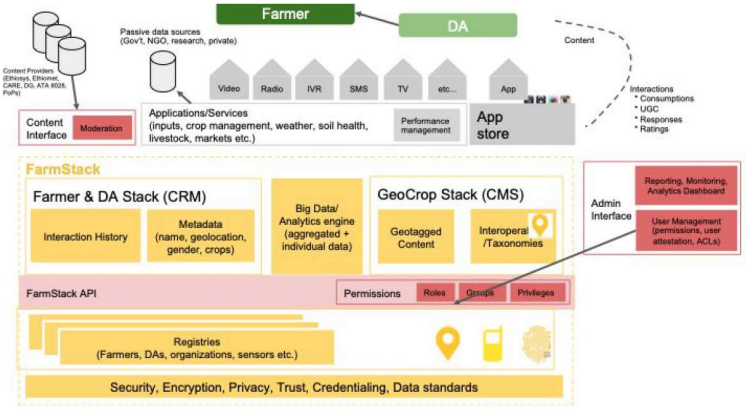
Sample BMGF investments

OPEN SOURCE PLATFORMS

- An open source digital platform for agricultural extension service
- Content management system
- Performance management
- Integration of multiple data sets
- Open, interoperable API's
- Multiple digital channels (e.g. IVR, Video etc.)
- Starting with 2 use cases (Dairy and Wheat) but expanding to others

FarmStack



Integrating Farm Data
Integrating Communication Channels
Integrating Market Services
Integrating Policies

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CGIAR – The largest international agricultural research network

- 130 agronomists engaged in > 140 projects, mainly through public funding
- New Excellence in Agronomy initiative

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New growth model: strong innovation

Cooperate more

Data-driven but human-centric

ROTHAMSTED RESEARCH

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