

A Conceptual Framework for Delivering Improved Fertilizers to Smallholder Farmers in Africa

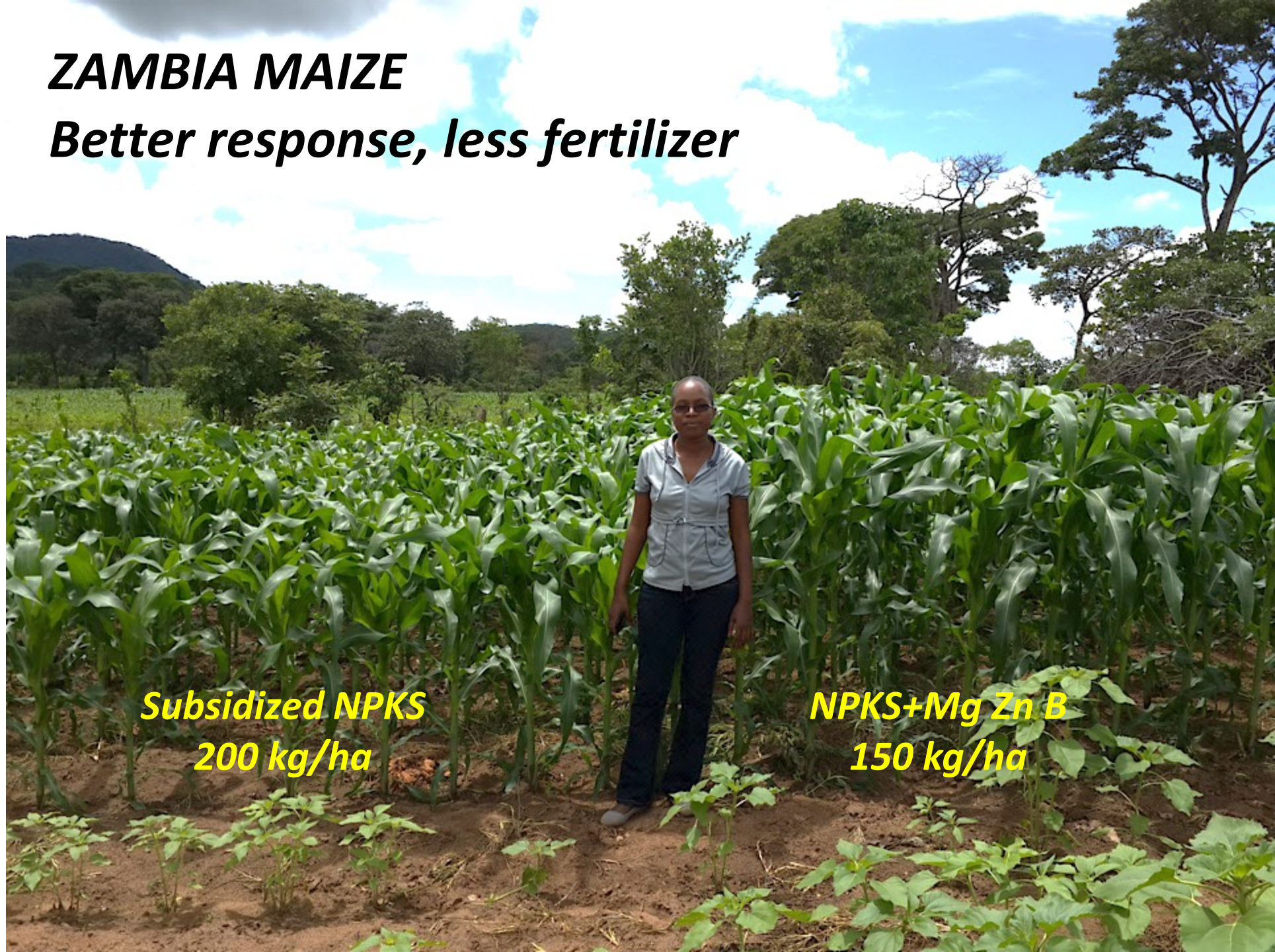
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ZAMBIA MAIZE

Better response, less fertilizer



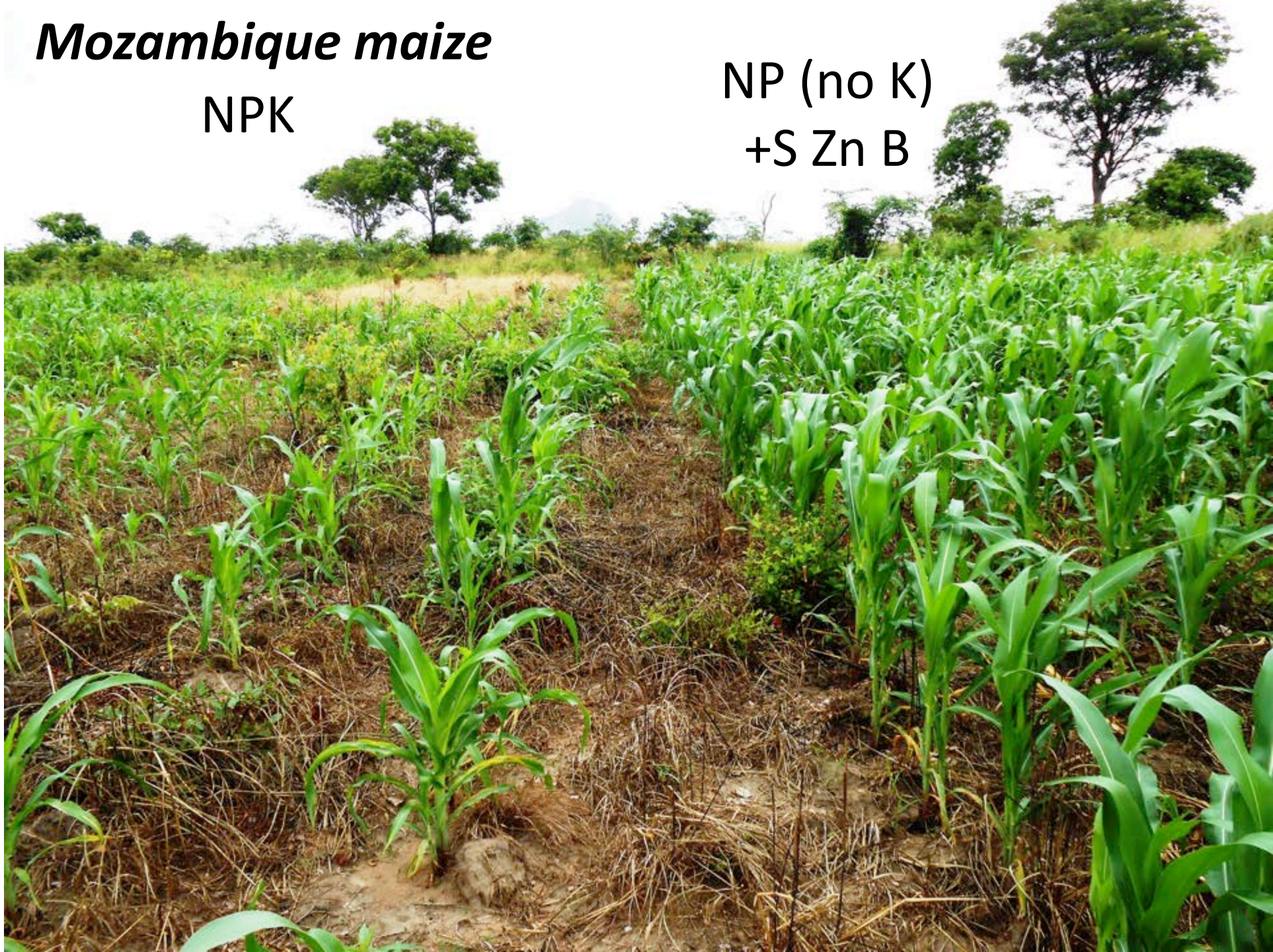
***Subsidized NPKS
200 kg/ha***

***NPKS+Mg Zn B
150 kg/ha***

Mozambique maize

NPK

NP (no K)
+S Zn B



Wheat, Ethiopia

NP only

NP
+S, Zn, B



Climbing beans and lowland rice, Rwanda



Commercial farmers

Soil/plant analyses



Professional recommendation



Custom Fertilizer
(requires large volume to manufacture economically)



The smallholder farmer reality

Full analyses often costly, not accessible

Crop-specific interpretations often not available through labs

Small soil and crop-specific volumes cannot be economically produced



The challenge



**Bring better fertilizers to
smallholder farmers, most of whom**

- cannot afford or access analytical services
- are purchasing in small volume
- are growing a variety of crops under different soil conditions



Begin with the end in mind



To begin with the end in mind means to start with a clear understanding of your destination. It means to know where you're going so that you better understand where you are now and so that the steps you take are always in the right direction.

— Stephen Covey —

AZ QUOTES

What is the destination?

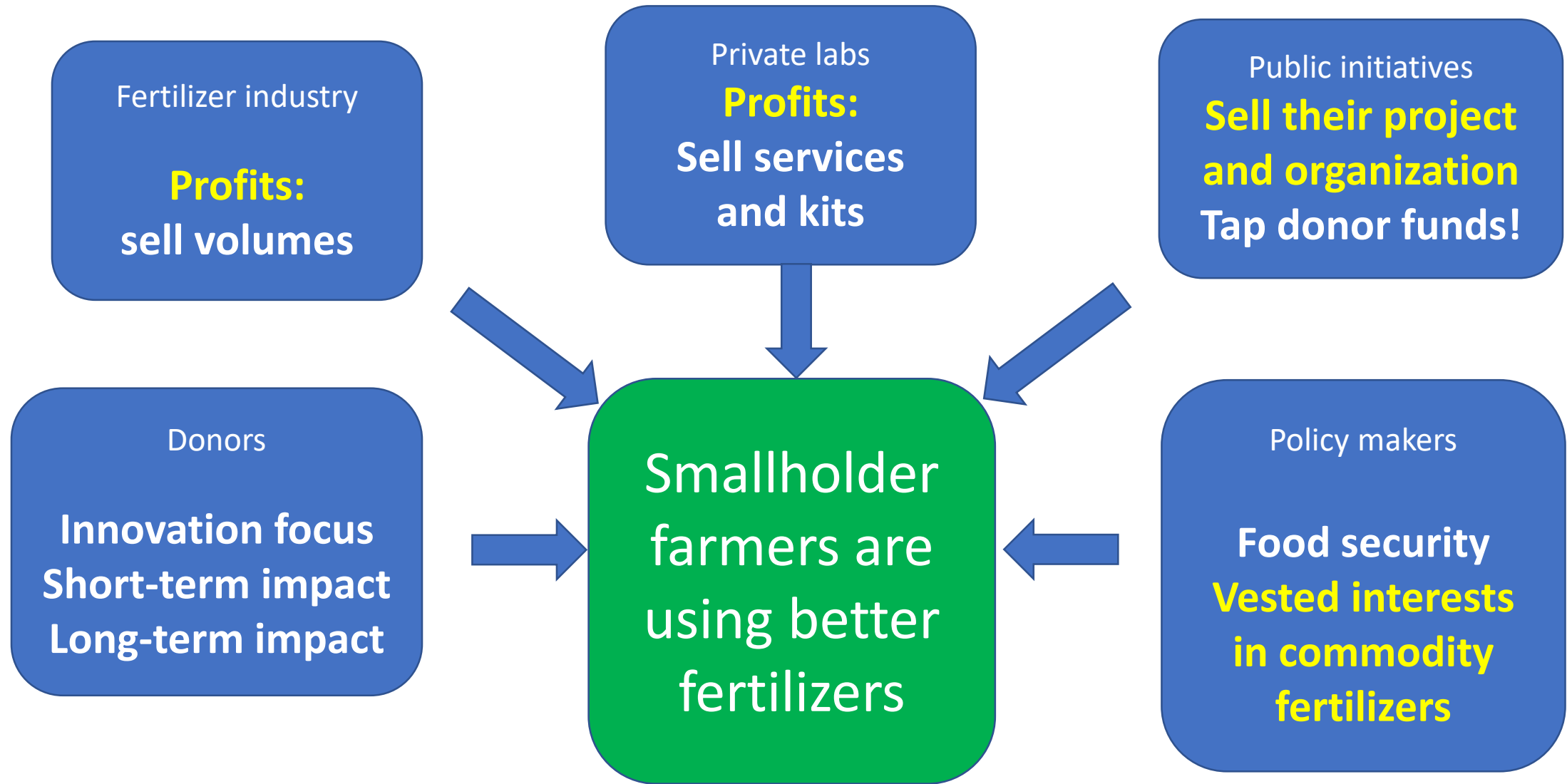


Farmers are using balanced fertilizers, resulting in sustainably higher yields and greater economic returns, compared to current fertilizer choices.

Implied: Fertilizer industry is producing, marketing, and delivering targeted fertilizer options to farmers to meet their diverse requirements

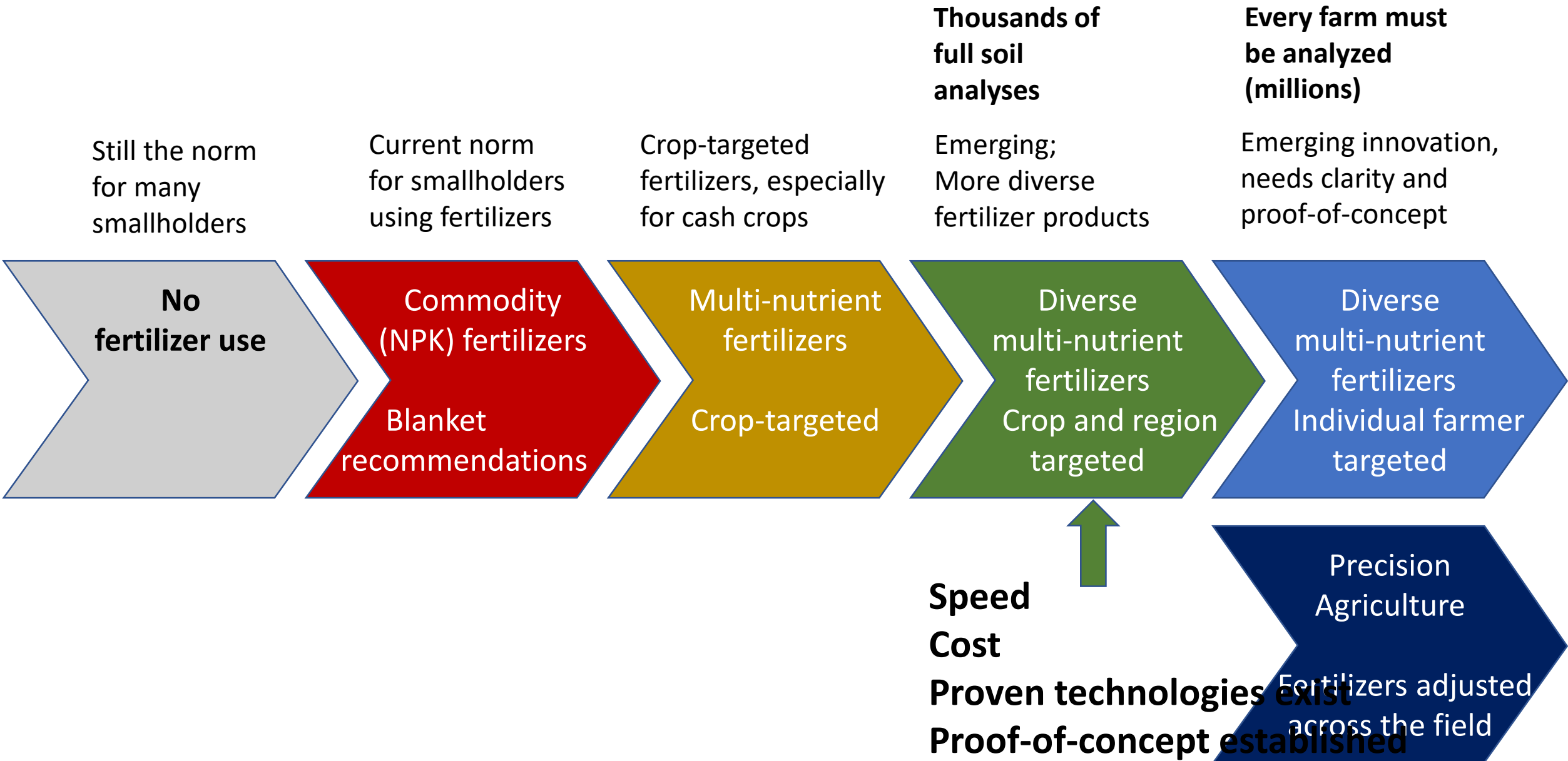
...with the END in mind!

Who are the stakeholders?



Each will act in their own best interests, yet we must work together

Phases in fertilizer evolution



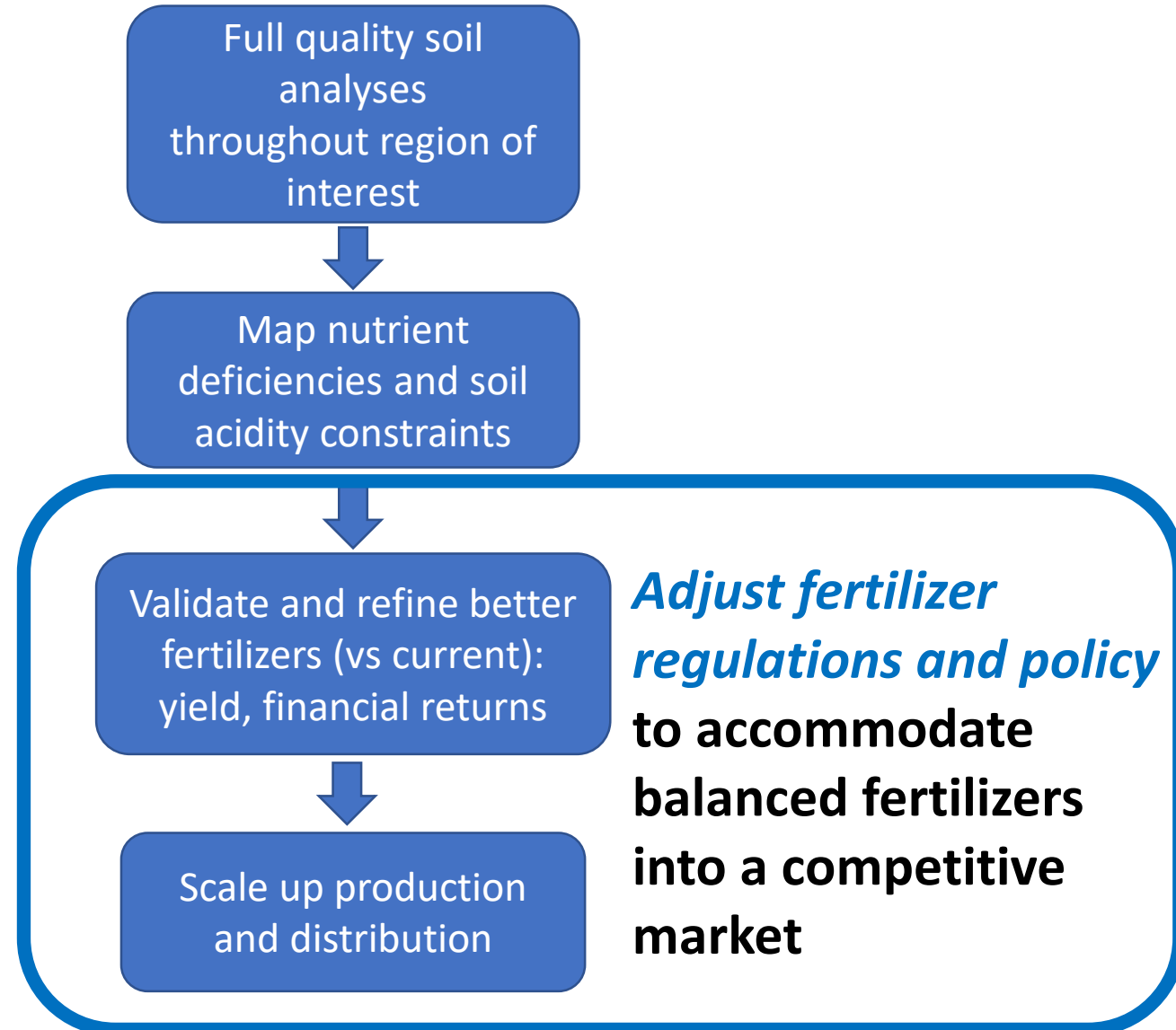
From soil analysis to smallholder fertilizer use: The **SMaRT** approach

Soil Analysis

Mapping

Recommendations
development

Transfer to farmers



Soil analysis

Requirements

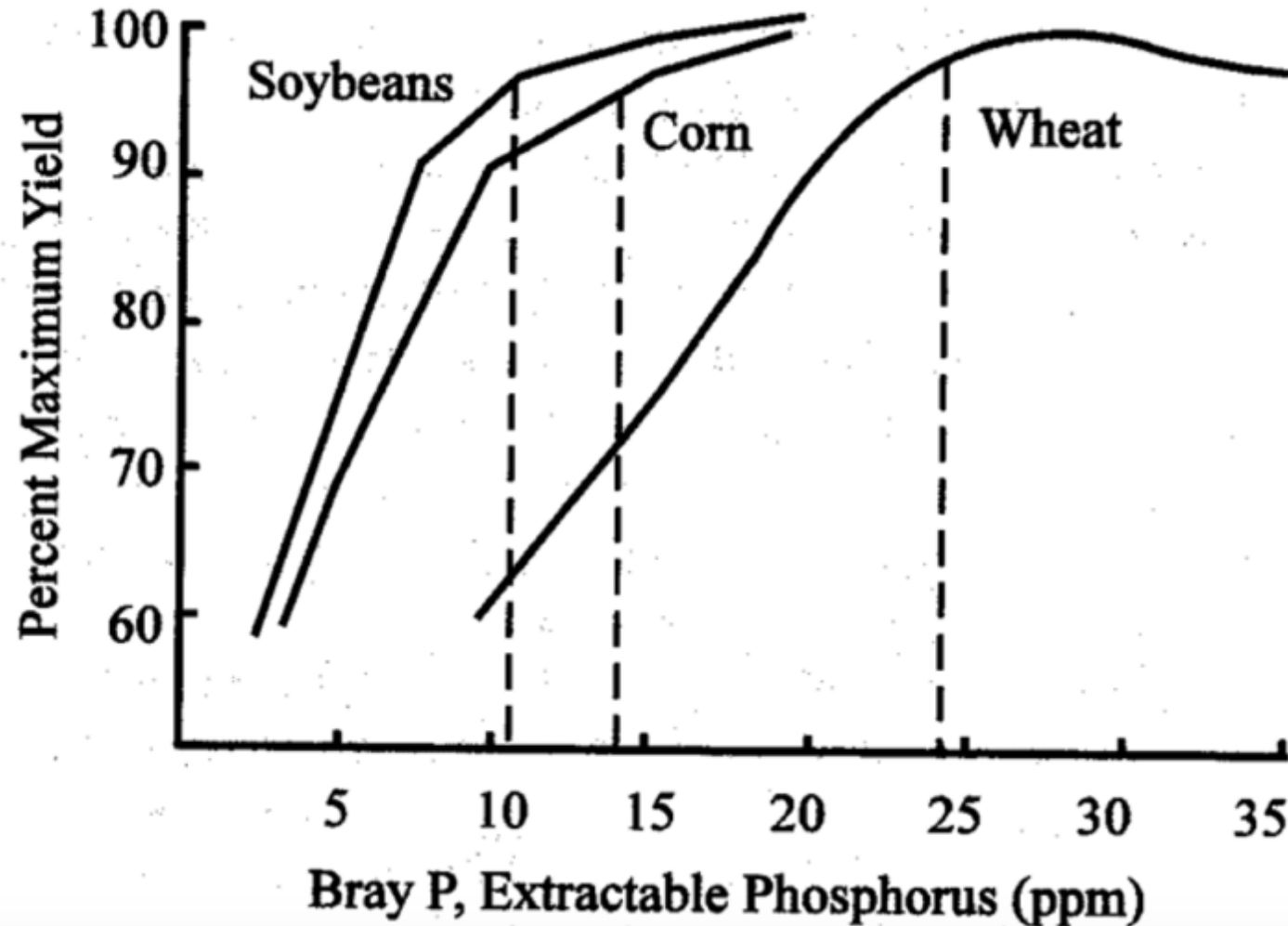
- **A full soil analysis** to assess all potential deficiencies and soil acidity constraints
 - Kits or methods that give partial soil analysis not appropriate at this level
 - Particularly true in SSA, where secondary and micronutrient deficiencies are widespread
- **Competent laboratories** using trusted methods
- **A sampling scheme** to assure good coverage at minimal cost

Soil analysis Interpretation

Interpretation of results is key to recommendations development

- **Experienced laboratories** may have spent years developing their interpretive criteria
- **National laboratories** and even researchers usually do not have this capacity
- **Interpretations are crop-specific.** What is sufficient for one crop is deficient for another.
- **Quality interpretations may involve multiple soil variables** for a single element

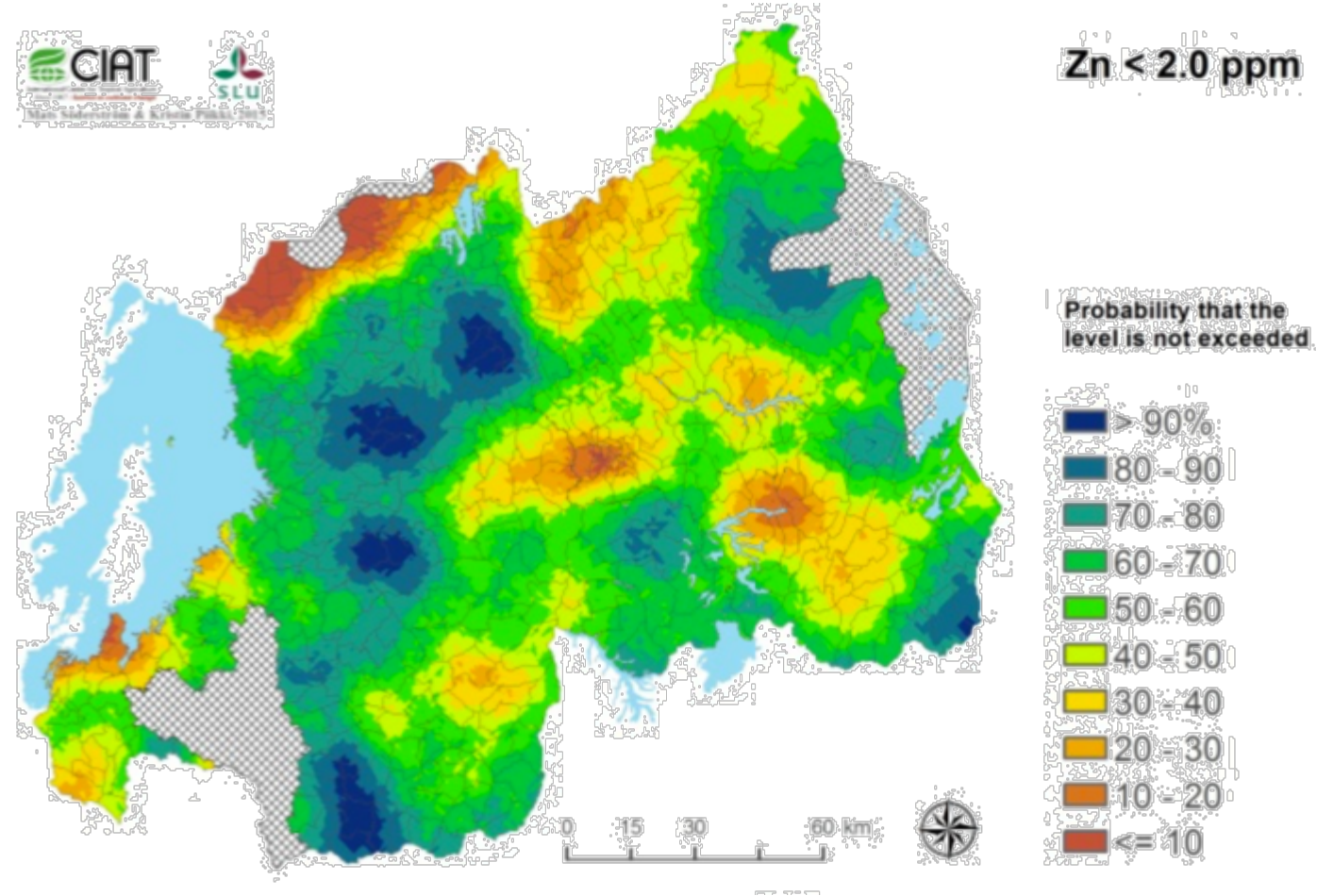
Different crops require different interpretation...



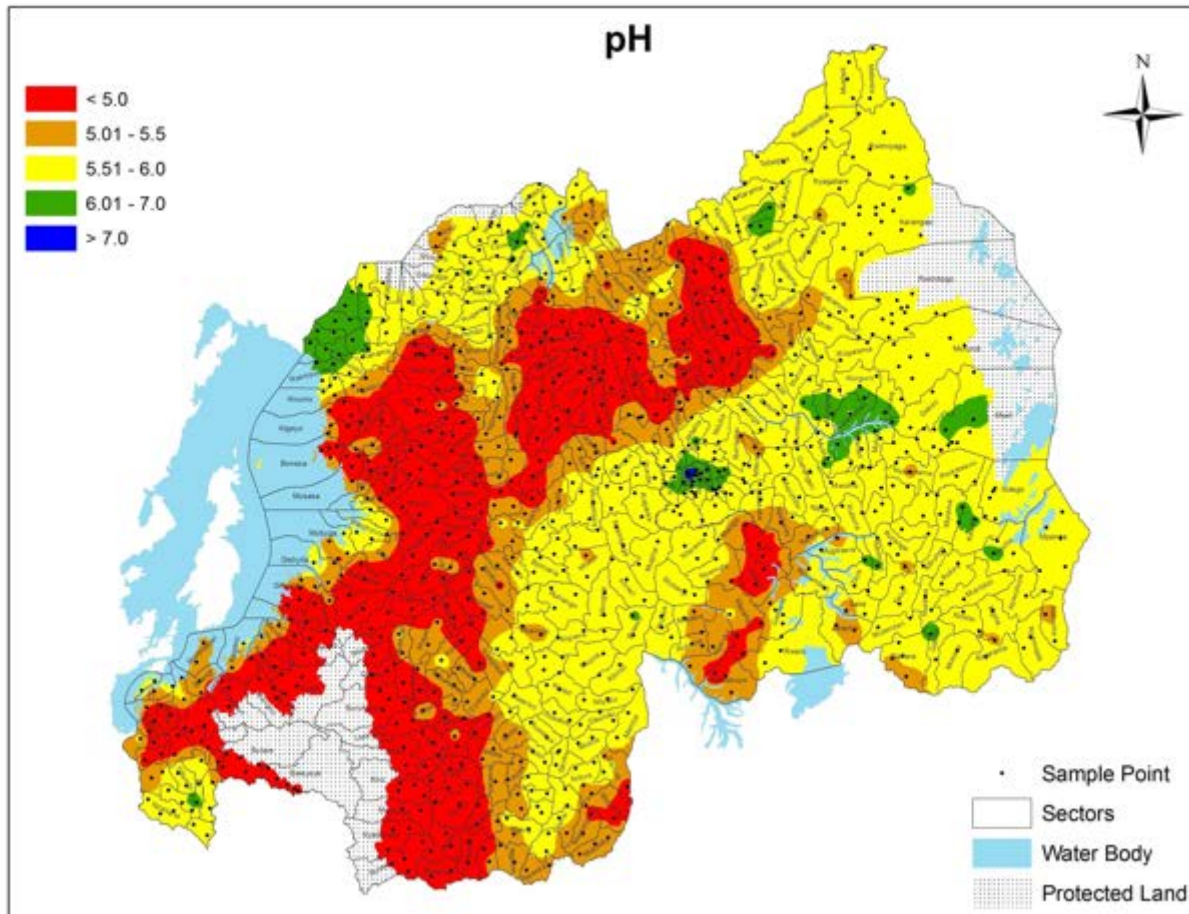
The same is true
for many
nutrients and
many crops

Mapping

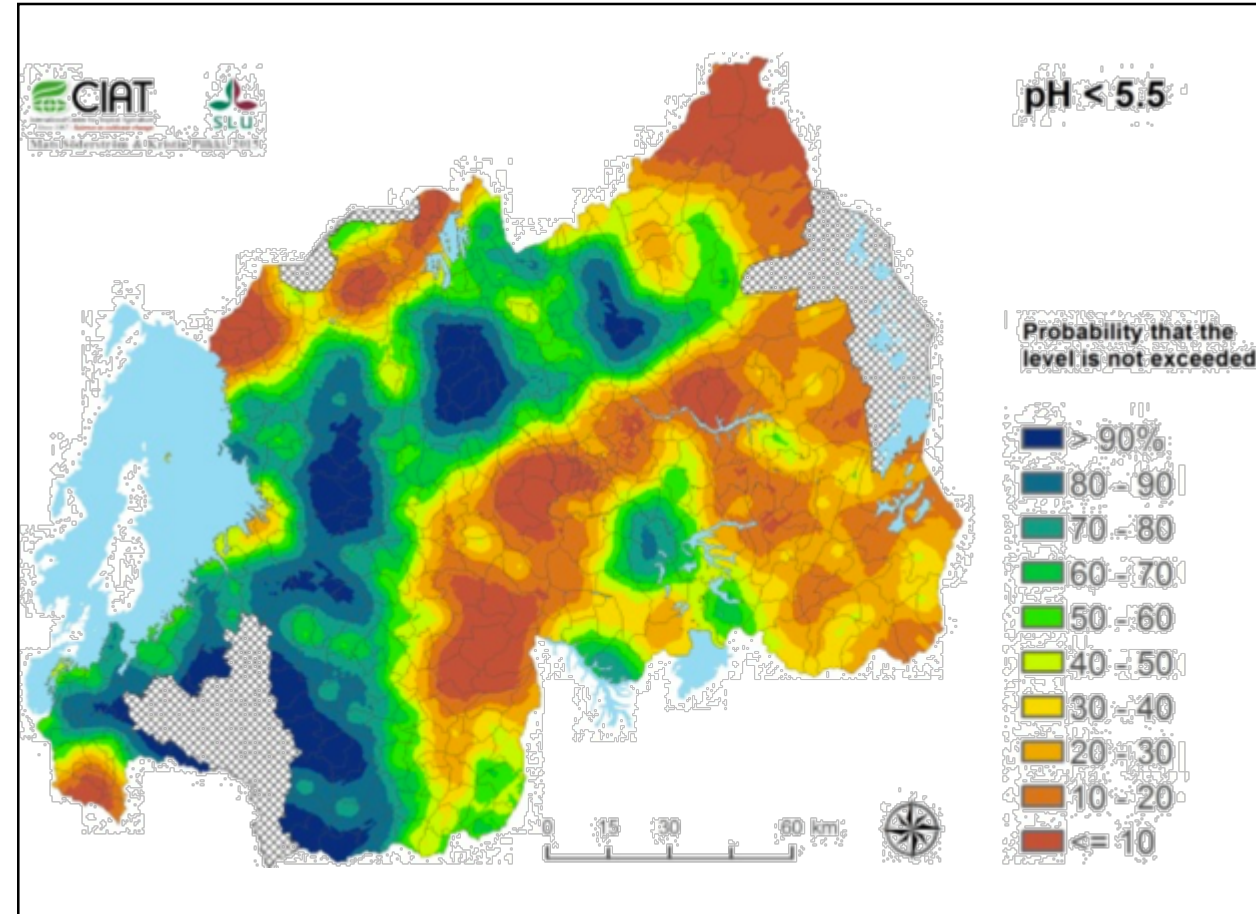
- Maps are important visual tools
- Influence policy-makers to understand the need for diverse fertilizer and lime products
- Guides the fertilizer industry regarding the extent and location of various deficiencies
- Can be combined with climatic, crop, and other maps to guide in government prioritization and fertilizer industry strategies



Different ways of mapping

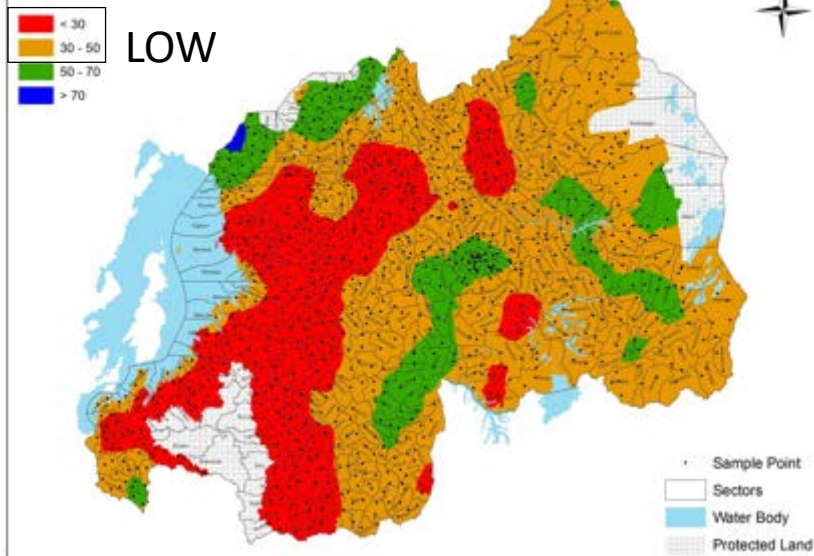


Crop Nutrition Laboratories, Nairobi

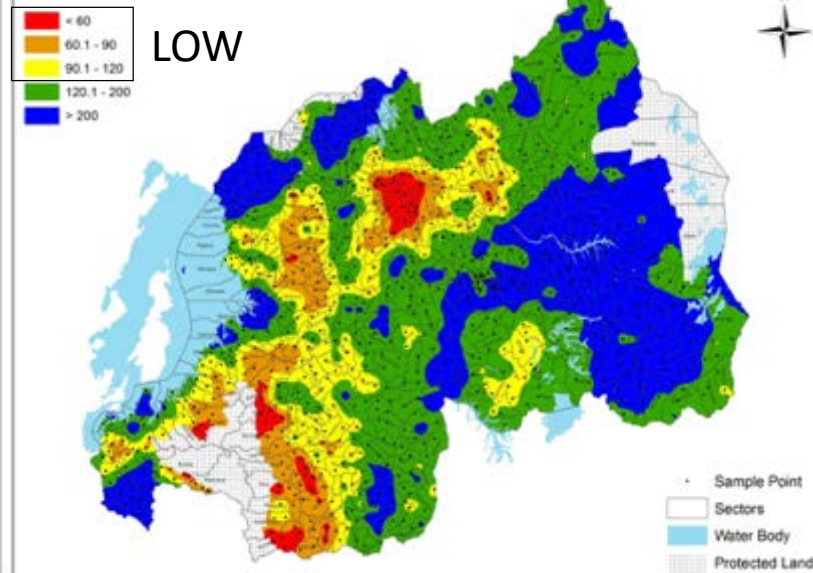


M. Söderström & K. Piikki, CIAT

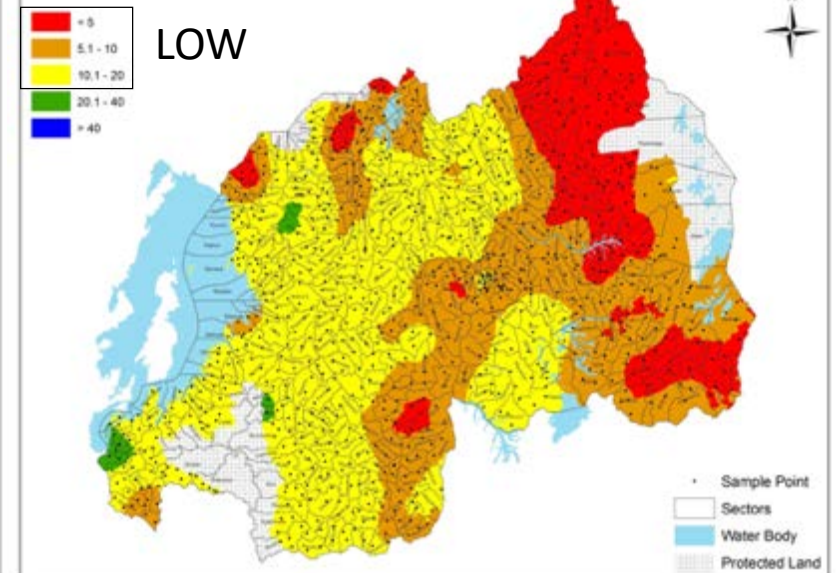
Calcium (%)



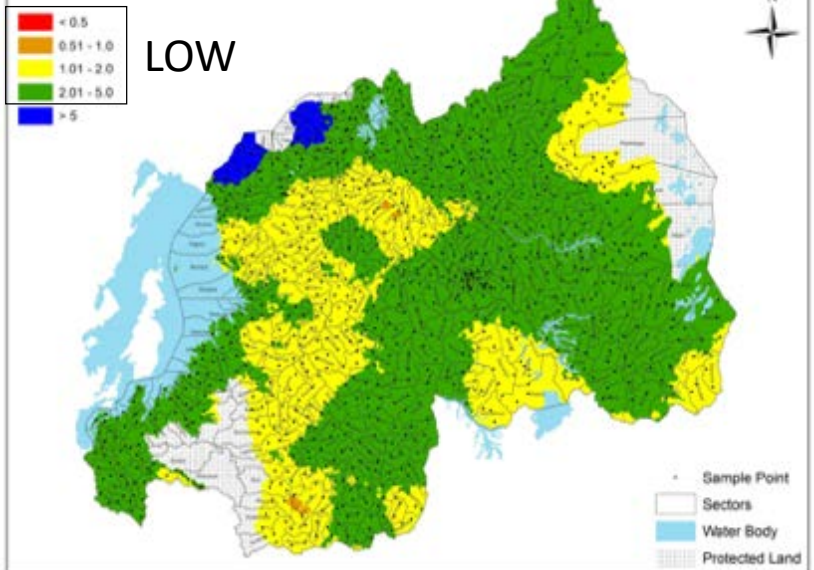
Magnesium (ppm)



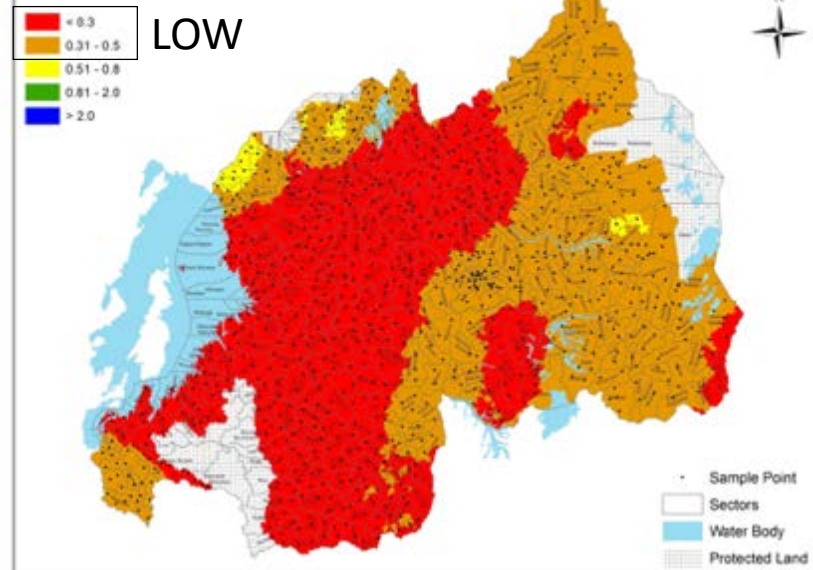
Sulphur (ppm)



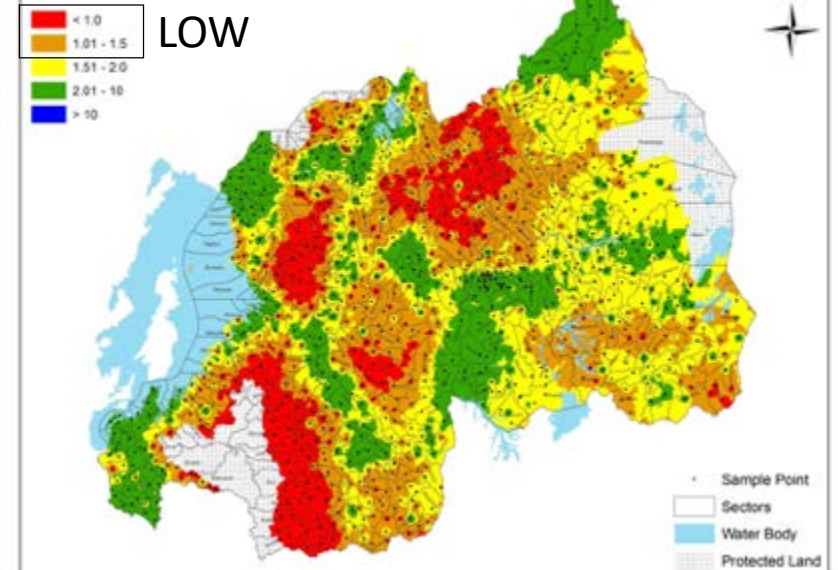
Zinc (ppm)



Boron (ppm)



Copper (ppm)



Recommendations development

What is a successful recommendation?

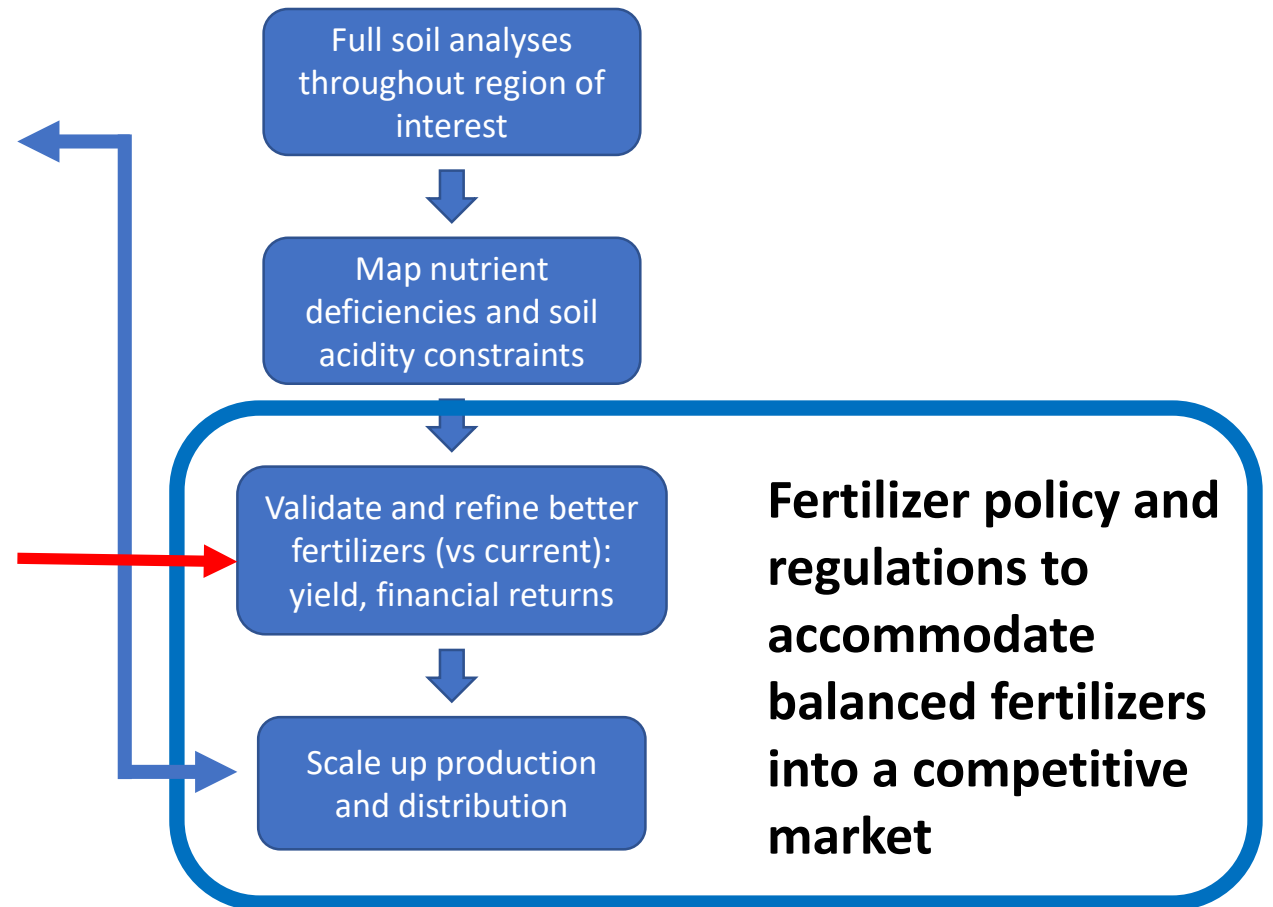
The smallholder context

- Addresses identified nutrient deficiencies
- Can **sustain yield targets** for the long term
- Needs to consider crop removal, and not just immediate soil conditions
- While not the perfect formulation, **is a substantially better formulation for most farmers** in terms of yield increase and economic returns
- **Is marketable** in terms of cost and production volumes to target farmers

Begin with the end in mind

Manufacturers are going to be producing the fertilizers, and will decide what they will or will not produce

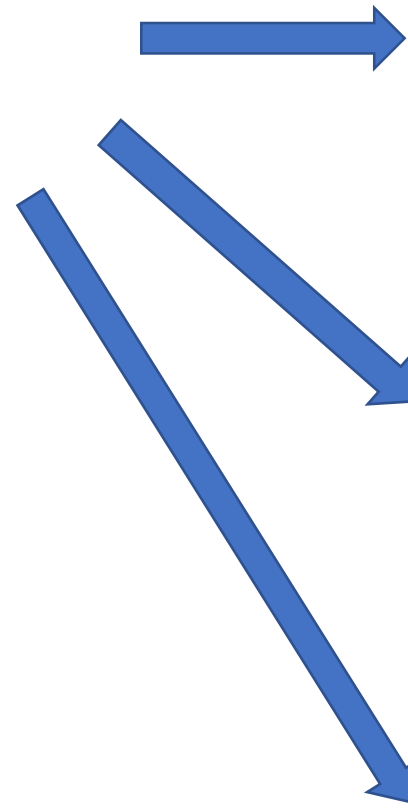
- ✓ When developing and validating formulae, work with the manufacturers so that what you develop will correspond to what they are willing and able to produce



- **Any of these three fertilizers may meet the same crop requirements,** but have somewhat different analyses and application rates, and practical production volumes
- Similarly, **identical formulations may perform differently in the field,** due to the ingredients and manufacturing processes used.

Take-away:

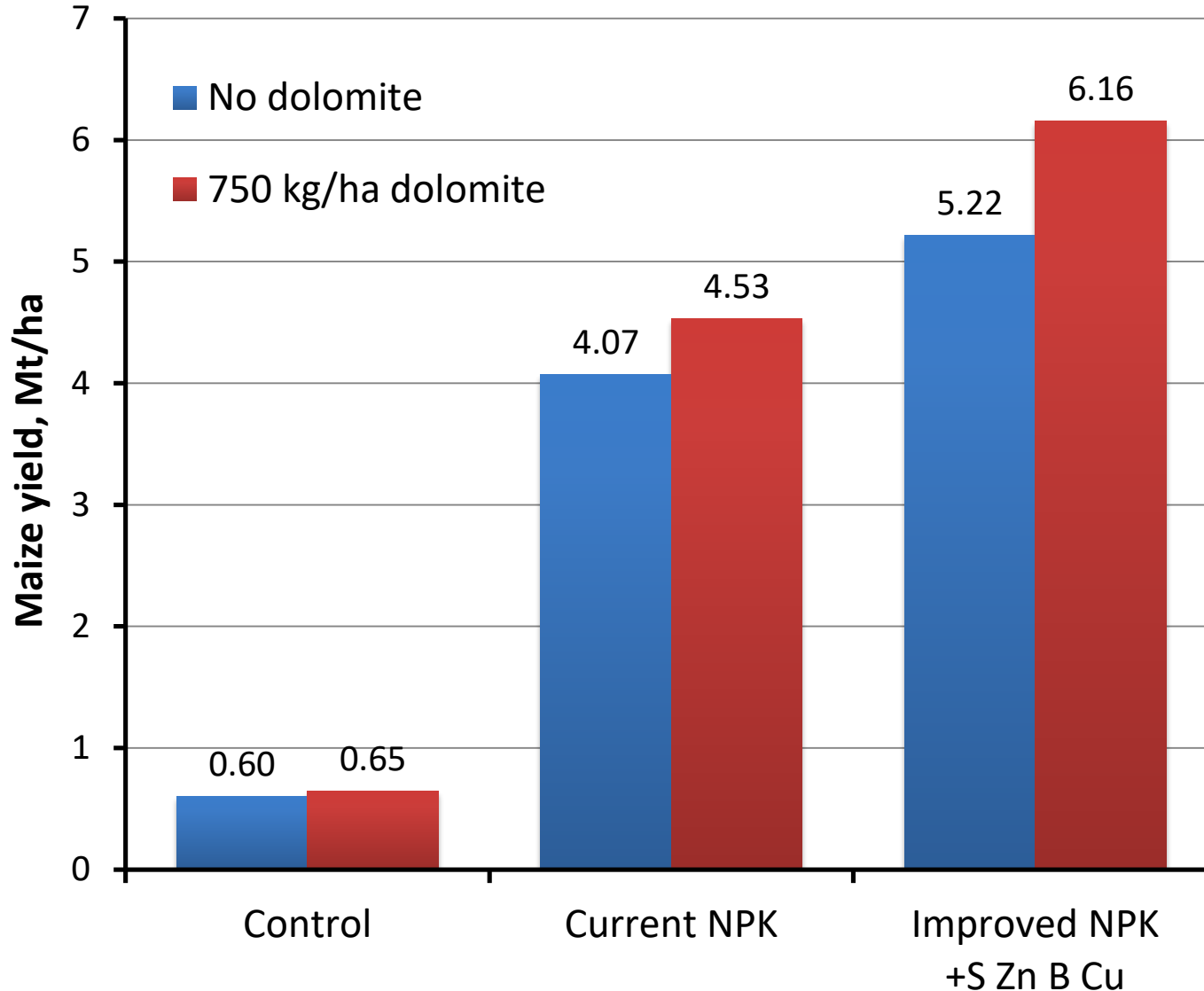
Work with industry manufacturers from the beginning, to assure that they are willing and able to produce what you develop together.



It is not a recommendation until validated

- **We do not make recommendations in SMaRT based on soil analysis alone**
- **Why?**
 - Many times, crop response does not follow the soil analysis recommendation!
 - A fertilizer company will not make a commitment to produce a new formulation without experimental evidence
 - Both yield and economic benefit must be affirmed
- One to two seasons of regional or national testing is usually sufficient to validate a better response

Best-bet and omission trials: in brief



Best bet: Compares options vs. “best bet” treatments, usually based on soil analysis

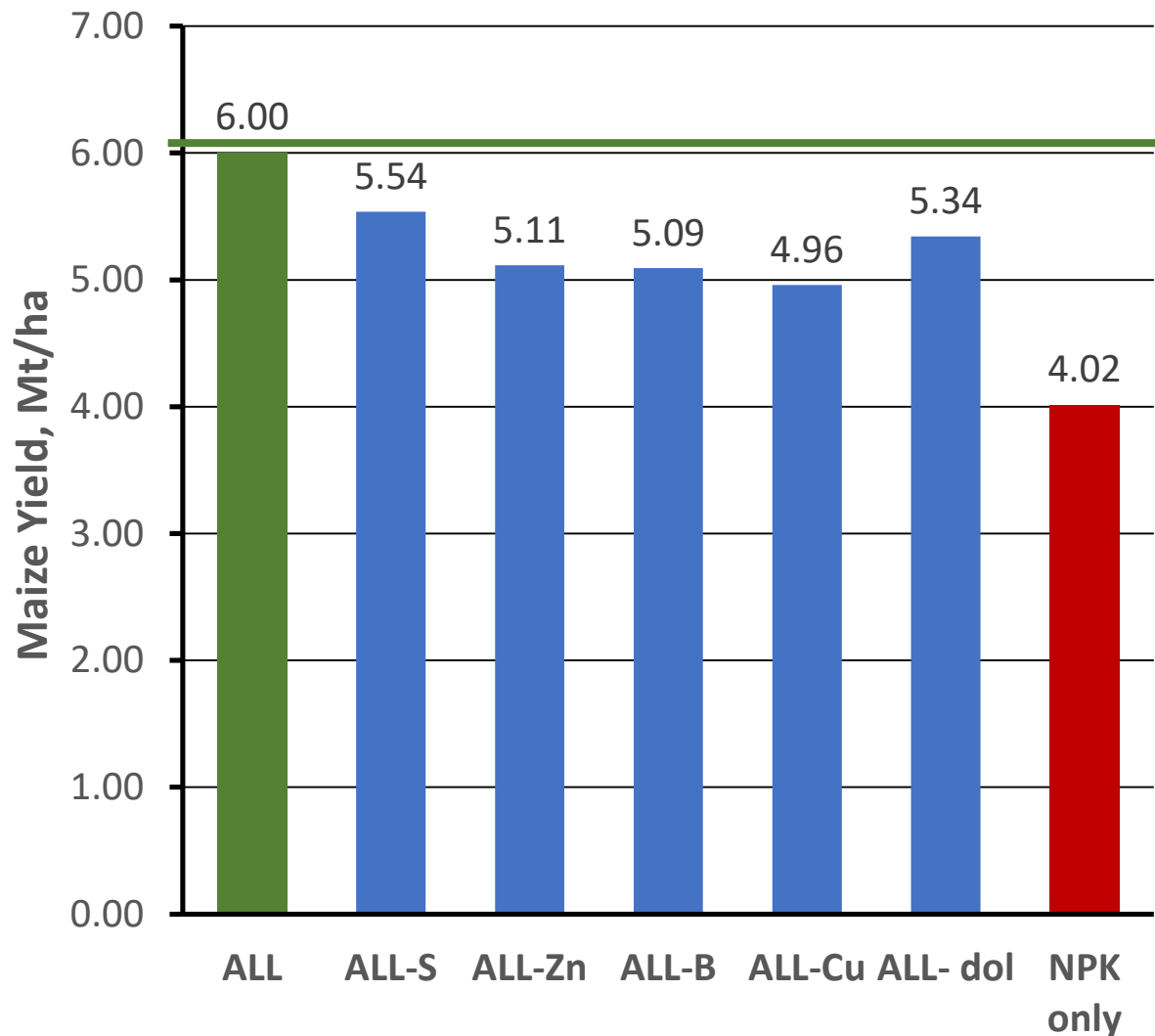
Conclusions that can be drawn:

- Is the new formulation better than the current one (yield and ROI)?
- Is either formulation economical to apply (vs. control)
- How does the new formulation perform with lime?

Omission trial example

	Treatment	N	P ₂ O ₅	K ₂ O	S	Zn	B	Cu
1	N P K S Zn B Cu (ALL)	64	46	30	10	0.6	0.30	0.25
2	N P S Zn B Cu (ALL-K)	64	46		10	0.6	0.30	0.25
3	N P K Zn B Cu (ALL-S)	64	46	30		0.6	0.30	0.25
4	N P K S B Cu (ALL-Zn)	64	46	30	10		0.30	0.25
5	N P K S Zn Cu (ALL-B)	64	46	30	10	0.6		0.25
6	N P K S Zn B (ALL-Cu)	64	46	30	10	0.6	0.30	
7	N P (Current)	64	46					

If omitted nutrient causes an economic yield loss, that nutrient is required.



Omission trials highlight the necessity of addressing all nutrient deficiencies

Omission: Evaluates the benefit of each added nutrient (or lime)

Conclusions that can be drawn:

- What is the contribution of each nutrient?
 - This assists in re-formulation.
- What proportion of the sites were economically responsive to each nutrient?
 - To decide if additional formulations are justified

Technology transfer

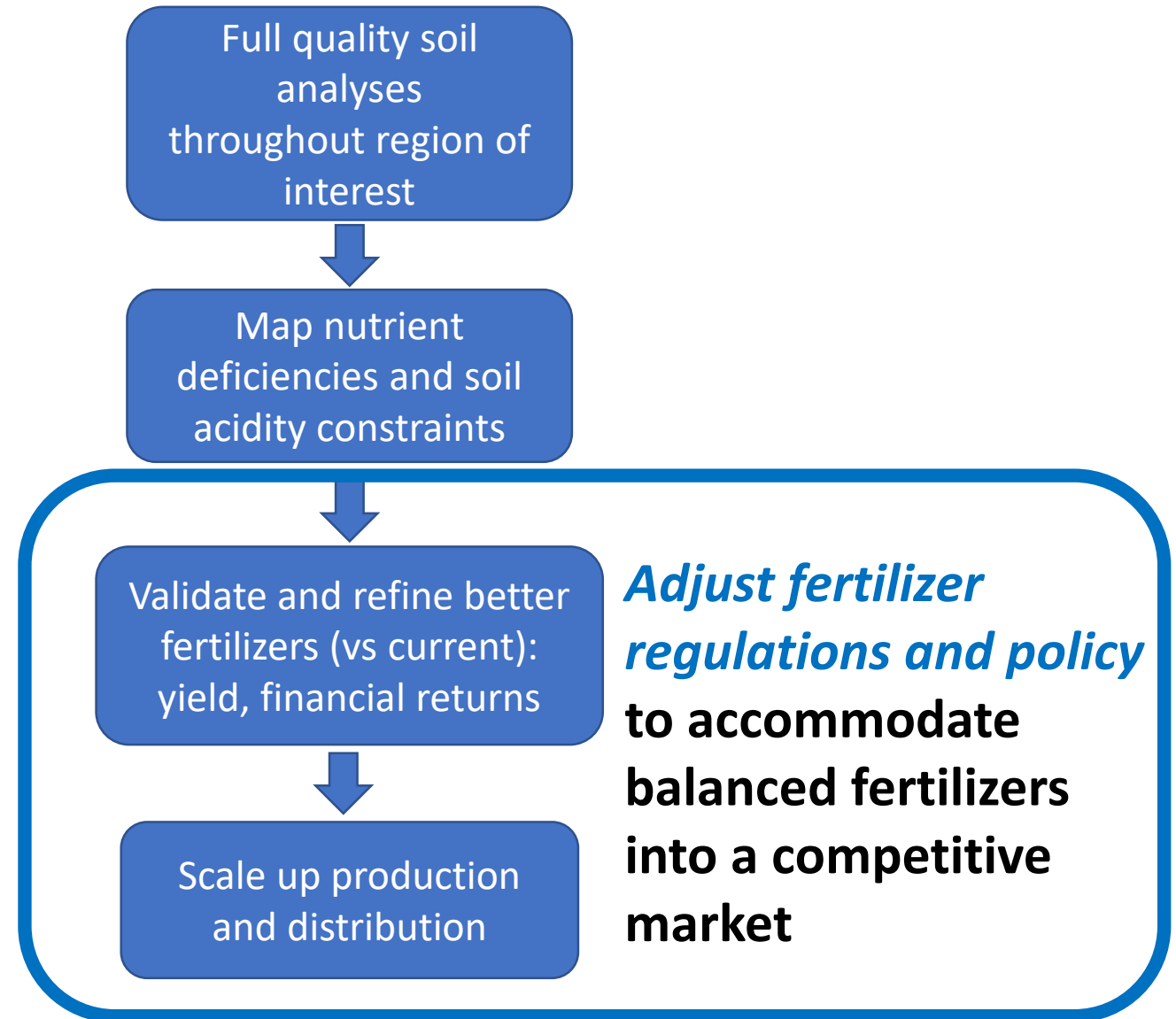
- Can be substantially shortened by working with the fertilizer industry, extension, and regulatory bodies from an early stage

Challenges

- Fertilizer acceptance by farmers (extension can help)
- Lack of a regional blender or international supplier interested in the market
- Lack of blending ingredients, especially for micronutrients
- Lack of a regional lime source
- Fertilizer regulations can be unfriendly to new products and fertilizer ingredients
- Various government policies (e.g., taxes, distribution networks)

Conclusions

- SMaRT is a strategic approach, built on lessons learned from both successes and failures, to rapidly get better fertilizers to smallholders.
- It depends on the essential participation of key stakeholders.



Conclusions

Functions of key stakeholders are inter-related—yet activities still “siloed”, not engaging one another and our skill sets.

This has led to slow progress.

An important goal:

Begin the process of developing collaborative mechanisms to enable necessary interactions of key stakeholders.

Soil/plant labs
Analytical and interpretive skills

Fertilizer industry
(Manufacturers, importers, blenders)
Knowledge base, Production & Marketing

Public initiatives
Trial work, Research & Extension, Innovation

Donors
Targeted, coordinated strategic investments

Smallholder farmers are using better fertilizers

Policy makers
Facilitating policy and regulatory environment

Agribusiness support
Market information
Market entry strategies
Infrastructure financing
Feasibility studies

GIS
Mapping, information gathering, synthesis, and diffusion

Thank you!



NPK

NP +S Zn B