# Blending Multi-Nutrient Fertilizers in Small Batches for Trials and Demonstrations

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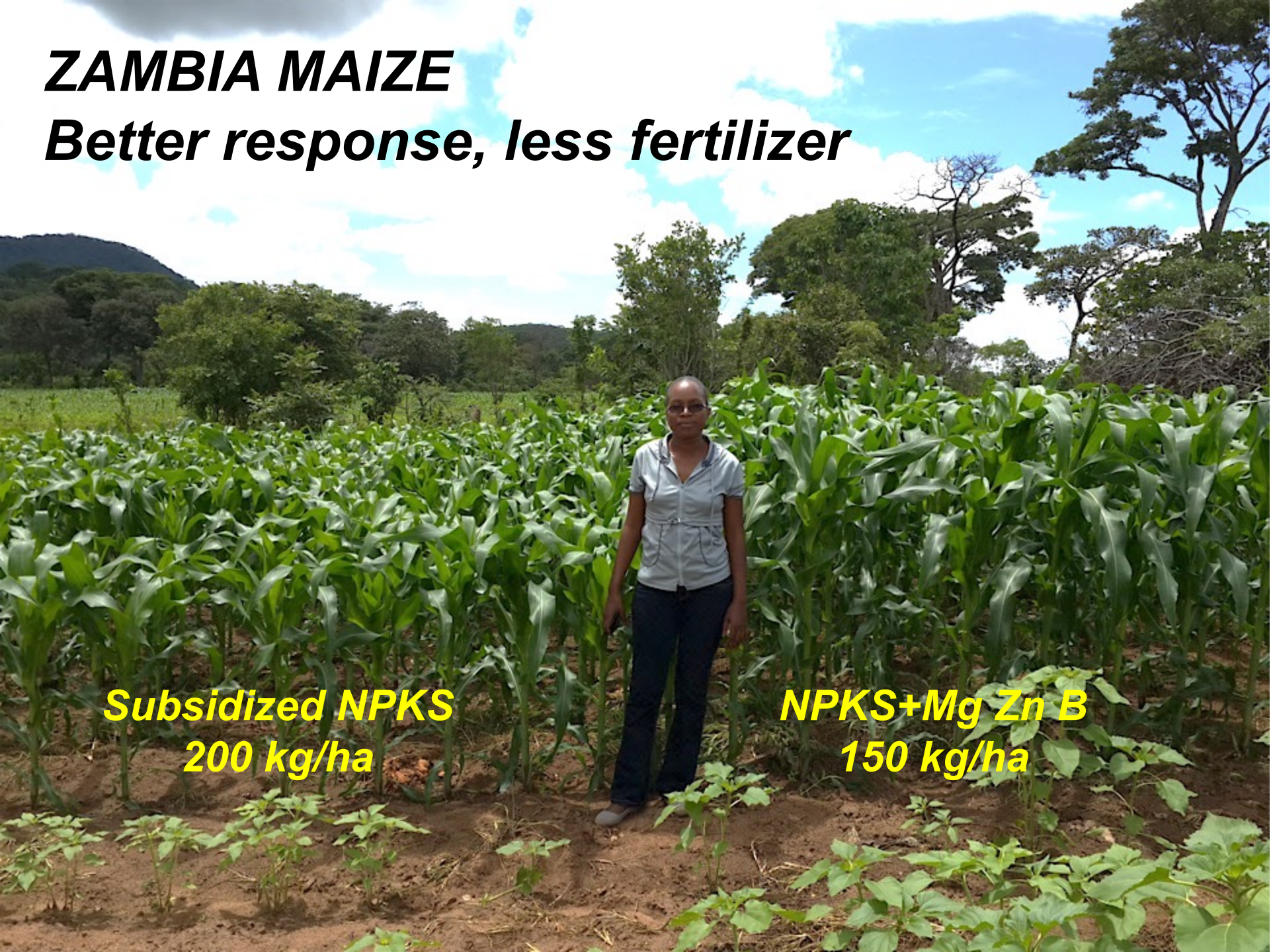
# *ZAMBIA MAIZE*
## *Better response, less fertilizer*

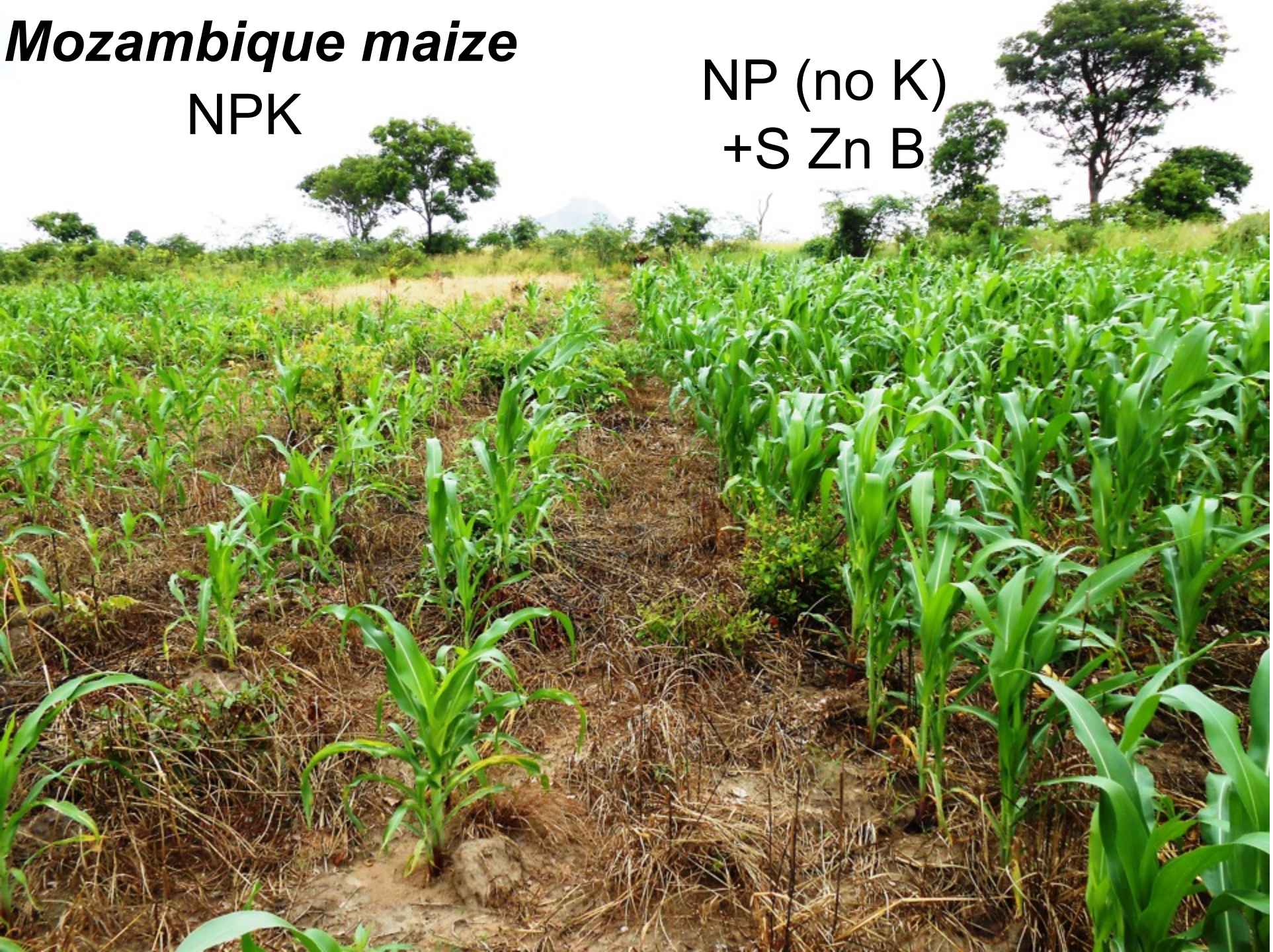



**A core IFDC strength:**

**Better Fertilizers**

IFDC

# *Mozambique maize*




IFDC


IFDC

# Climbing beans and paddy rice, Rwanda


# Seminar contents

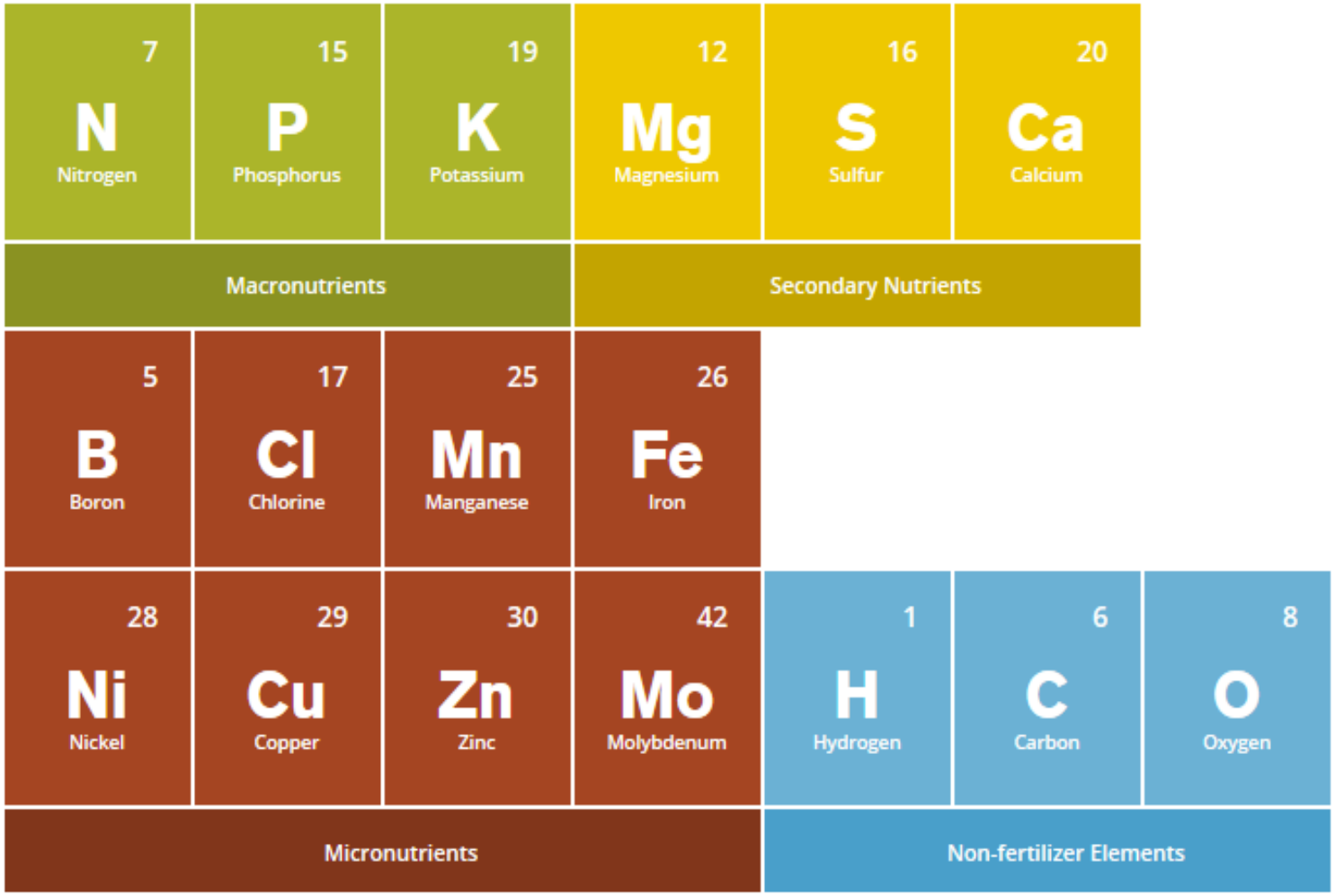
- Essential plant nutrients and balanced fertilizers
- The SMaRT Concept and the need to verify fertilizer effectiveness
- Why blend fertilizers in small batches?
- The 5Rs of fertilizer blending
- What are the principles regarding selection of ingredients, rates and sources?
- What is the evidence of efficacy?
- YouTube video demonstrating the blending process

# Essential plant nutrients

N, P and K are the primary macronutrients, the basis of most fertilizers

Mg, S and Ca are the secondary macronutrients, required in lesser quantities

Micronutrients are usually required at less than 1 kg of nutrient per ha



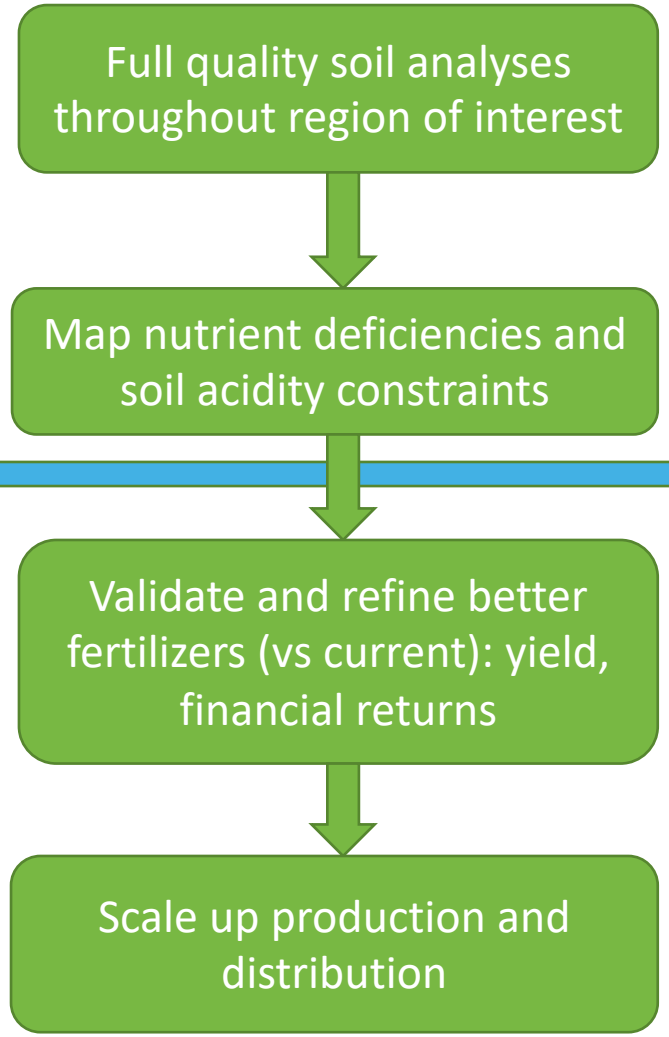
# From soil analysis to smallholder fertilizer use: The SMaRT approach

**S**oil Analysis

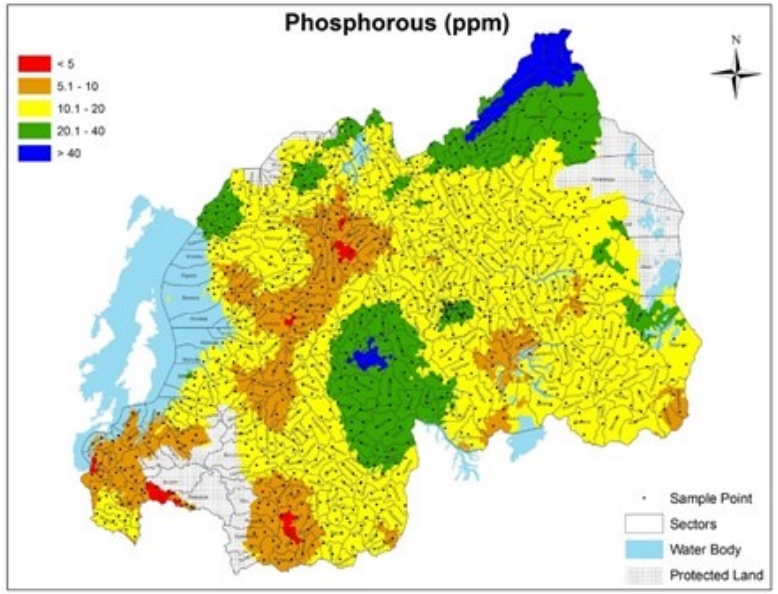
**Ma**pping

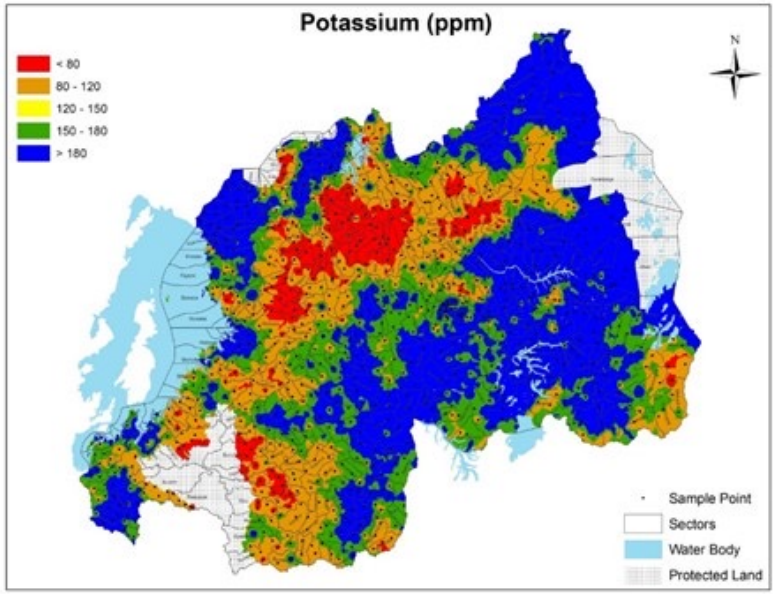
**R**ecommendations development

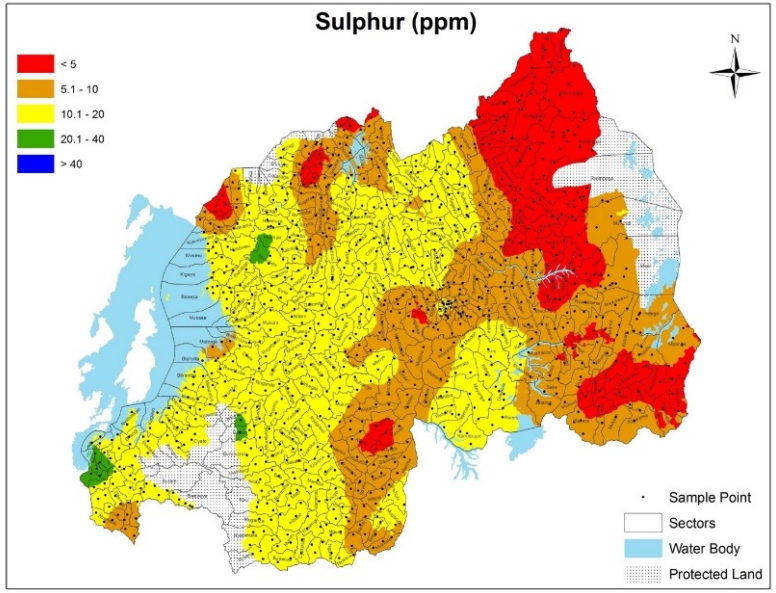
**T**ransfer to farmers

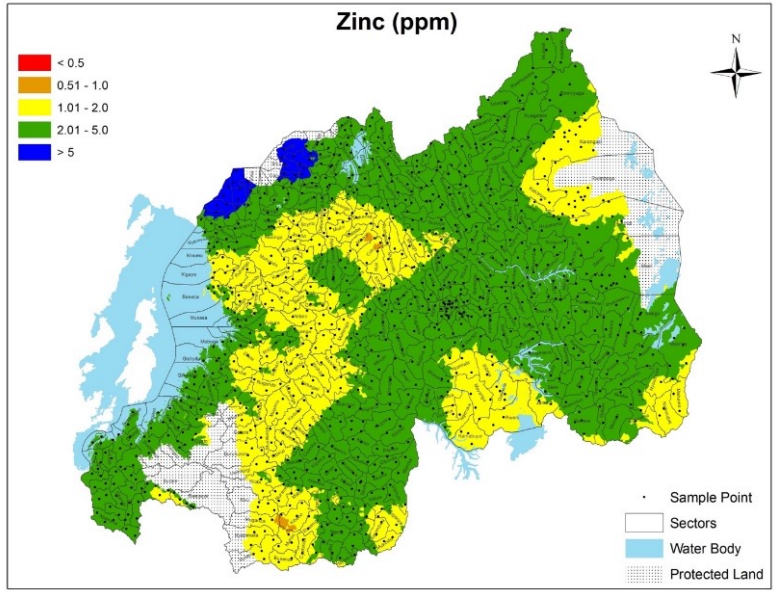


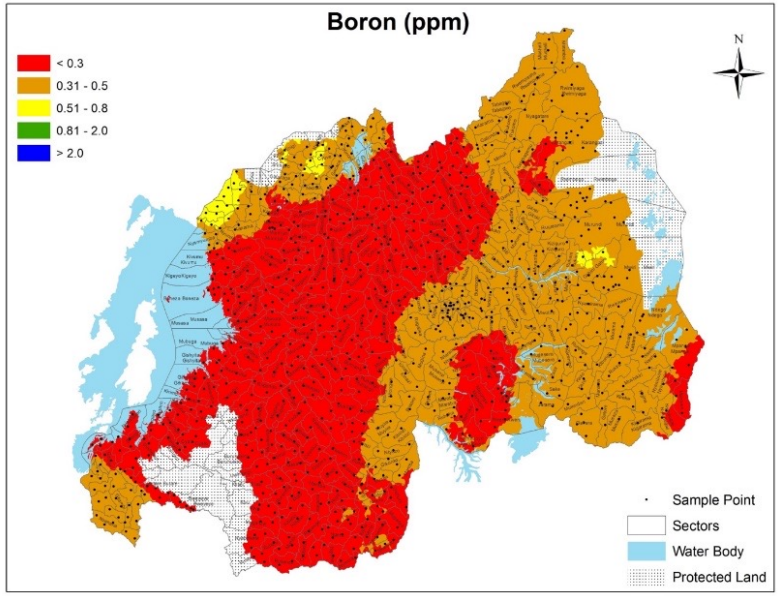
# Rwanda Soil Nutrient Maps (from 1000+ samples)

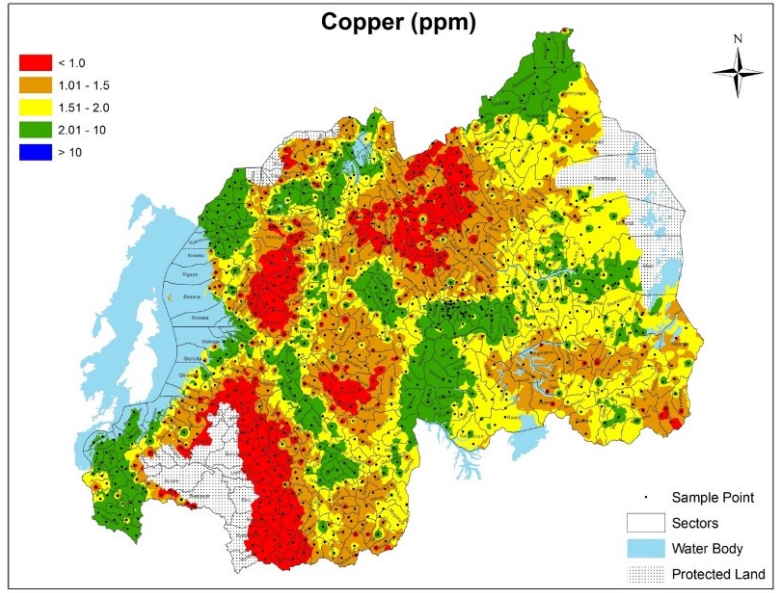


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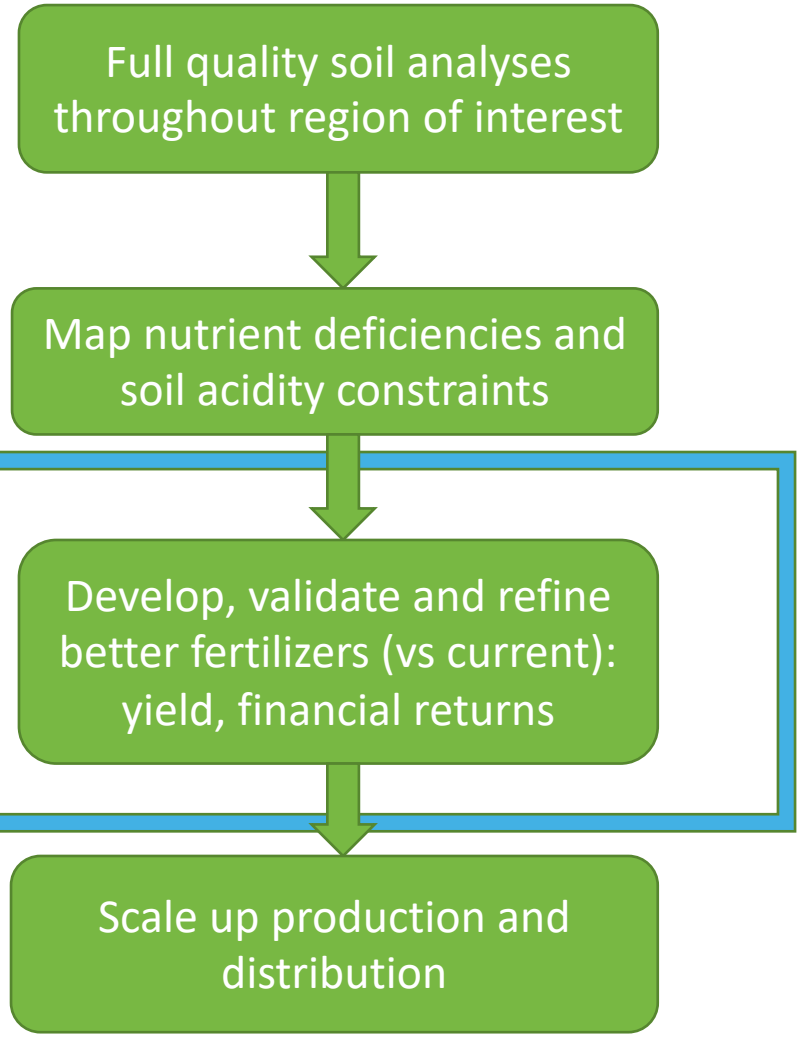


# Why do we need to blend small fertilizer batches?

## Recommendations Development

### Which nutrients belong in the fertilizer?

- **Omission trials:** Several formulations required, each one omitting one nutrient

### Validation of formulations over a large region

- Fertilizer must be evaluated over a large region to justify production
- Must offer substantial improvement over currently used fertilizers
- May want to demonstrate or test multiple formulations

***To run these trials and demonstrations, small batches of unique fertilizer formulations are required.***

# 5Rs of fertilizer blending

**Right nutrient source:**

- Compatibility of fertilizer ingredients in blends
- Economical (source cannot cost too much)
- Nutrient availability (e.g., zinc from sulfate, oxide, sub-micron oxide, or chelate)
- Correct particle size for the process (granular or powder)

**Right rate:**

- Too little will not give an effective response
- Too much can be expensive or toxic

**Right time:**

- Nutrients usually added to the planting (basal NPK) fertilizer
- Some can also be added to the topdress fertilizer which supplies N

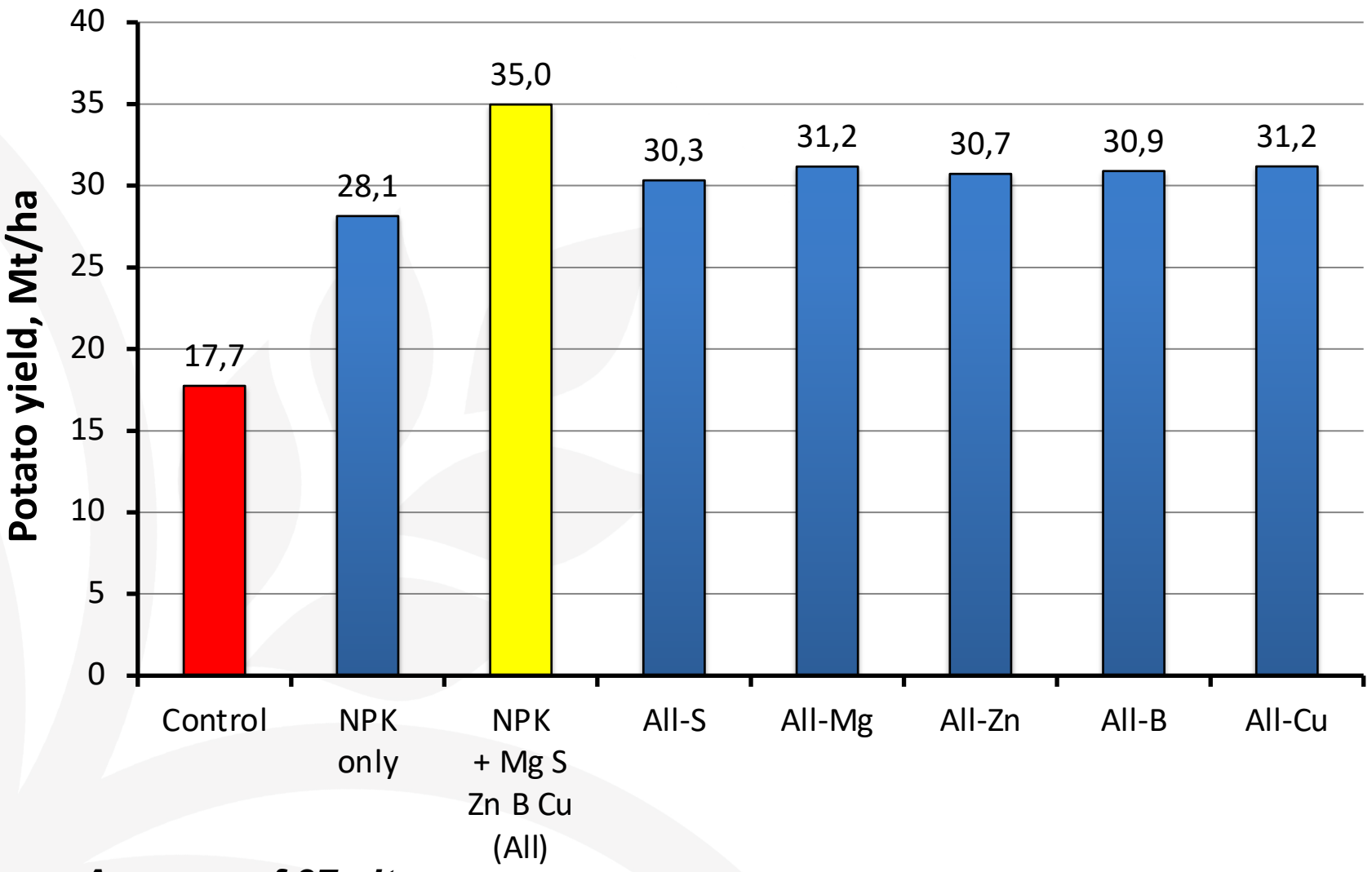
**Right nutrient inclusion:**

- All nutrient deficiencies need to be addressed.
- Failure to address any single nutrient deficiency will limit response to the others (Liebig's Law of the Minimum)
- Adding unnecessary nutrients is costly

**Right micronutrient distribution:**

- Coating vs. granular micronutrients

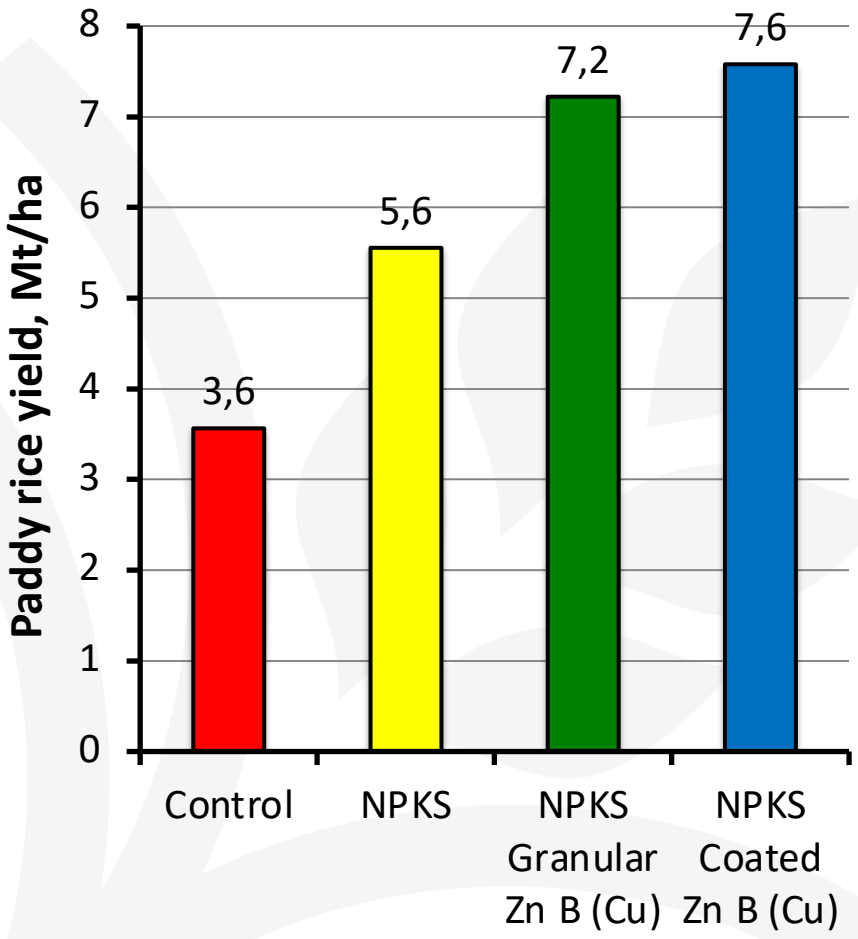
# Right nutrient inclusion



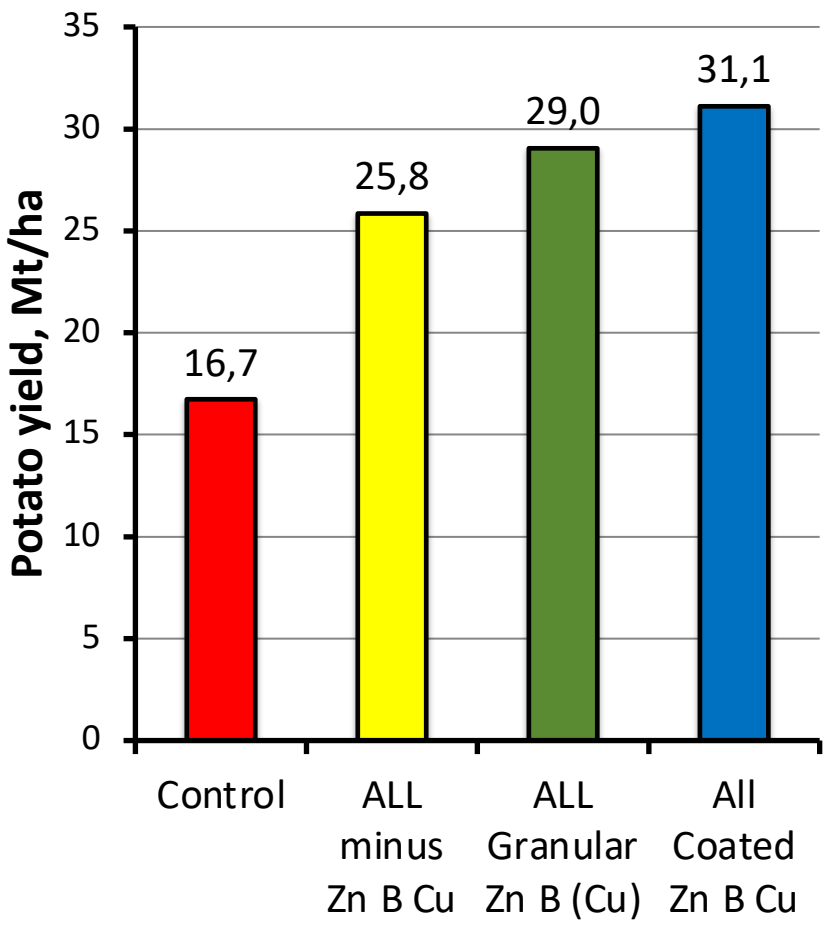

***Average of 37 sites***

- Failure to include any one of 5 deficient nutrients markedly reduces overall yield response (more than 4 t/ha)
- The majority of past research has addressed only one or two deficiencies

# Granular vs. Coated Micronutrients: *Rwanda Rice and Potato*




***Average of 35 sites***




***Average of 47 sites***

**Granular rates**

- Zn 2.5 kg/ha
- B 1.0 kg/ha
- (Cu) 0.3 kg/ha

**Coating rates**

- Zn 0.5 kg/ha
- B 0.3 kg/ha
- Cu 0.25 kg/ha

# IFDC Principles for Trial and Demo Implementation using Fertilizer Blends

**Small batches should duplicate what would be done at a commercial blender**

- Same ingredients
- Same particle sizes
- Same proportions of ingredients
- Same processes (e.g., micronutrient coating)

**Fertilizers are best applied in trials/demos the same way that a commercial blend will be applied**

- NOT multiple applications for individual nutrients
- NOT multiple placement methods

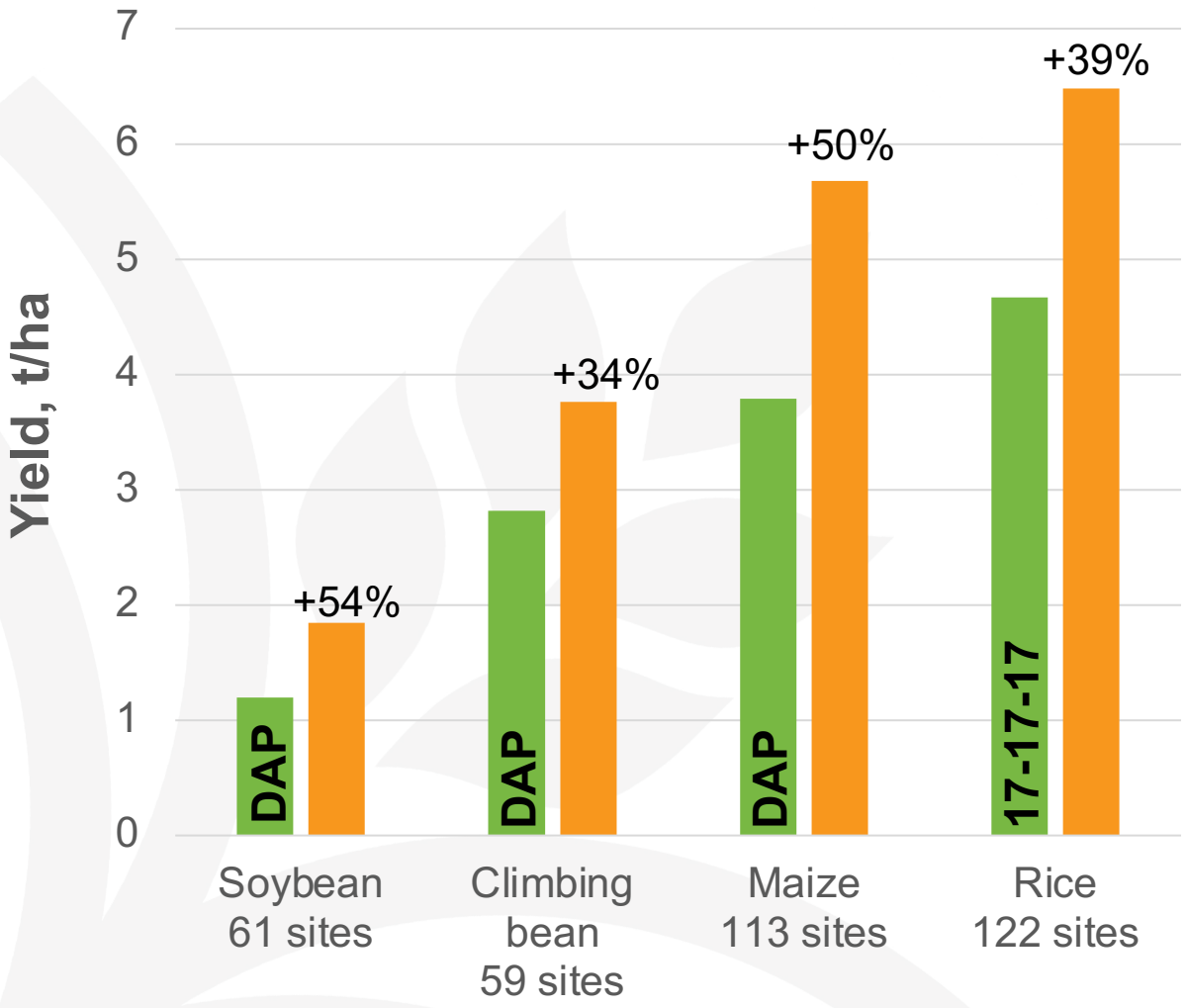
These principles ensure that

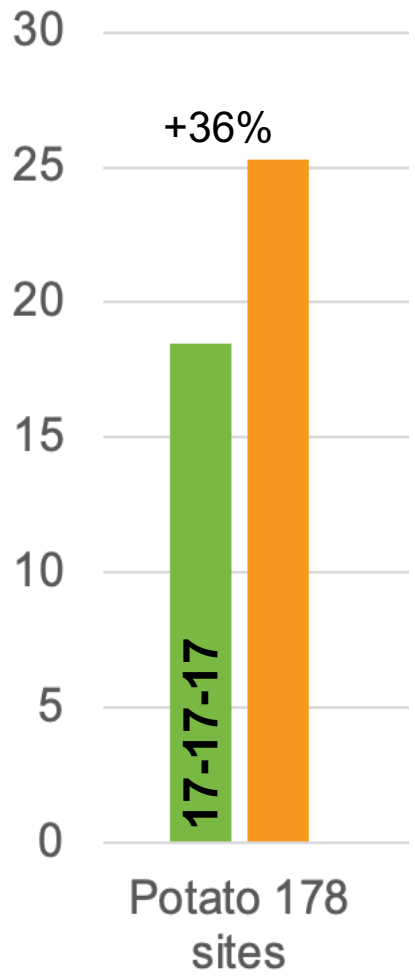
- field trial blends can be directly transferred to commercial blending
- trial response will represent commercial product response

# How did we develop our rates and sources for various non-NPK nutrients?

- Consultation with commercial blending companies
- Discussions with manufacturers of various micronutrient additives
- Examination of patents for various products
- **Field trial validation and refinement (didn’t just take their word for it!)**

# Efficacy in Rwanda: Yield improvements vs. DAP and 17-17-17




Multi-nutrient formulations:

| | |
|---|---|
| Soybean | NPK +S Zn B Cu |
| Cl. Bean | NP +S Zn B |
| Maize | NP + S Zn B Cu |
| Rice | NPK + S Zn B Cu |
| Potato | NPK + S Zn B Cu |

**Improved formulations applied at the same rates as DAP and 17-17-17**

# FREQUENT MIS-STEPS

**Failure to consult with ingredients manufacturers or experts in the blending industry→**

- Using ingredients that are too costly or incompatible
- Using inappropriate rates
  - Too much: Toxic or cause negative nutrient interactions
  - Too little: Not effective
- Not adjusting micronutrient rates according to form
  - Granular micronutrients vs. coated micronutrients
  - Oxides vs. sulfates for zinc

# FREQUENT MIS-STEPS

- Not addressing multiple deficiencies simultaneously
- Over-reliance on soil analytical values (critical values) to select nutrients
- Using different placement methods for different ingredients in omission trials
- Not testing a blend (or compound) before manufacture and distribution

# Making Fertilizer Blends in Small Batches

**VIDEO**

https://www.youtube.com/watch?v=zO7KzhHlunw