Influence of soil fertility variability and nutrient source on maize productivity and nitrogen use efficiency on smallholder farms in Zimbabwe

Shamie Zingore

International Plant Nutrition Institute, Sub-Saharan Africa Program

szingore@ipni.net

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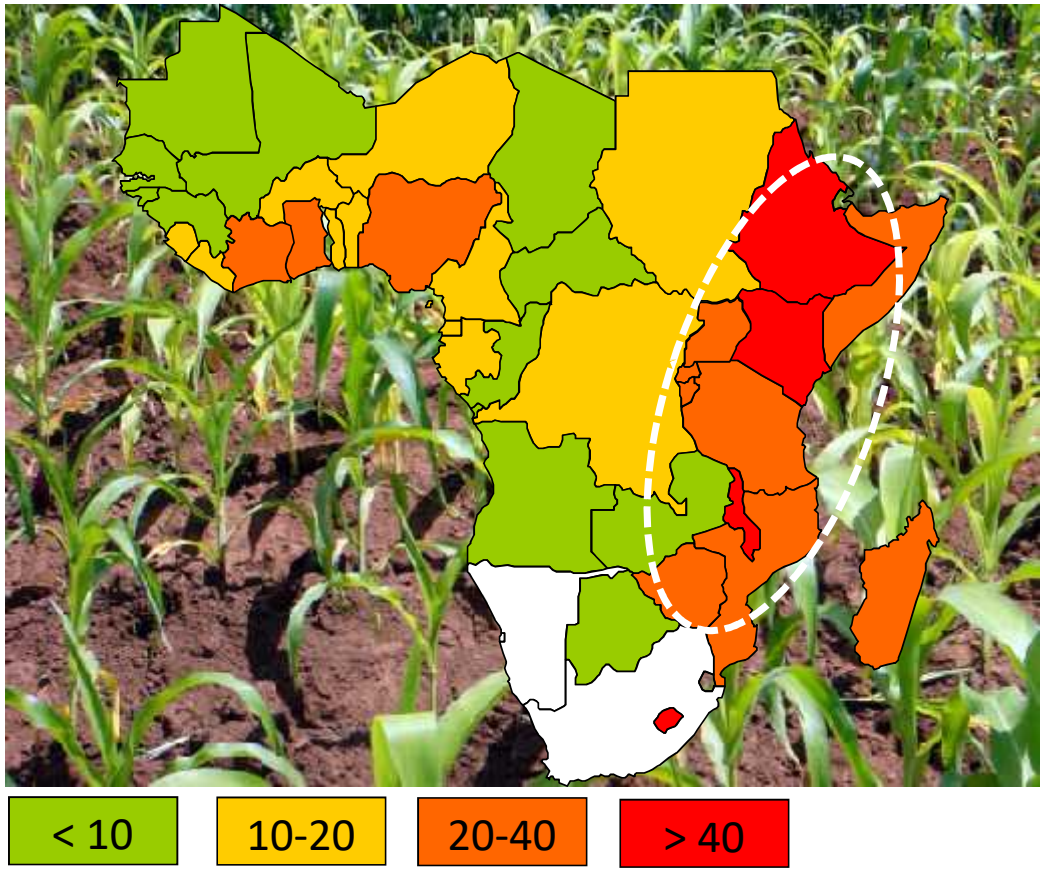
1) Introduction: Status of N use and maize yields

- Low maize productivity in SSA associated with low nutrient use (<15 kg N/ha)
- Yields of <2 t/ha are lowest globally
- N recognized as the most limiting nutrient in maize production
- N balances are highly negative in maize-based systems
- High prevalence of degraded soils



Negative annual nitrogen balances

1) Introduction: Challenges of N use

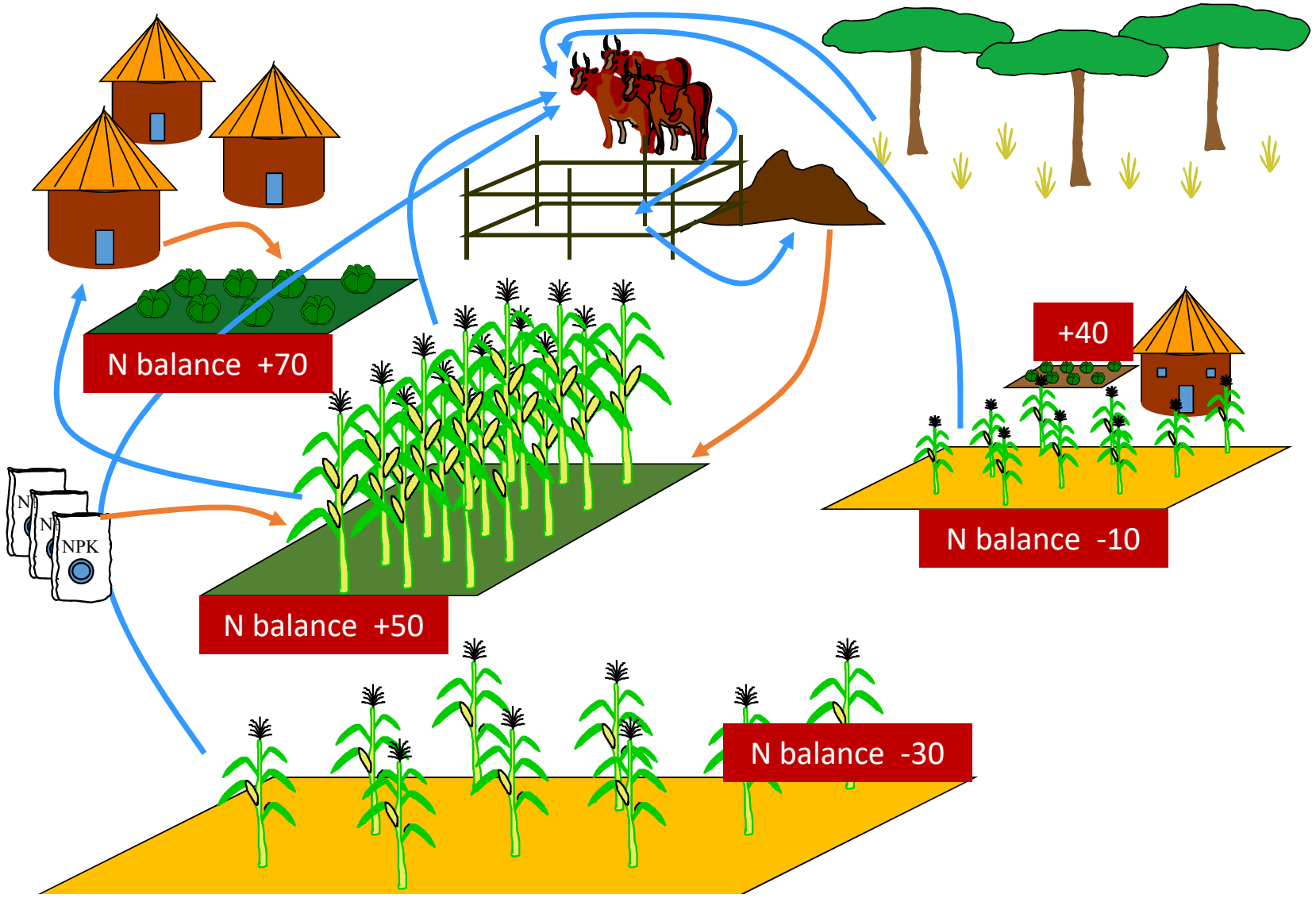
- Sustainable maize production intensification depends of effective N management
- N use efficiency very low when farmers increase fertilizer use
- Multiple challenges for N management
  - Soil fertility variability
  - Multiple and complex constraints to crop production
  - Land degradation

Subsidy program in Malawi and Kenya

Yield (kg/ha)	Fert. Use Intensity (kg/ha)	Fert. N Use Intensity (kg/ha)	Agronomic N use eff. (kg/kg)
1.9	**102**	**38**	**12**

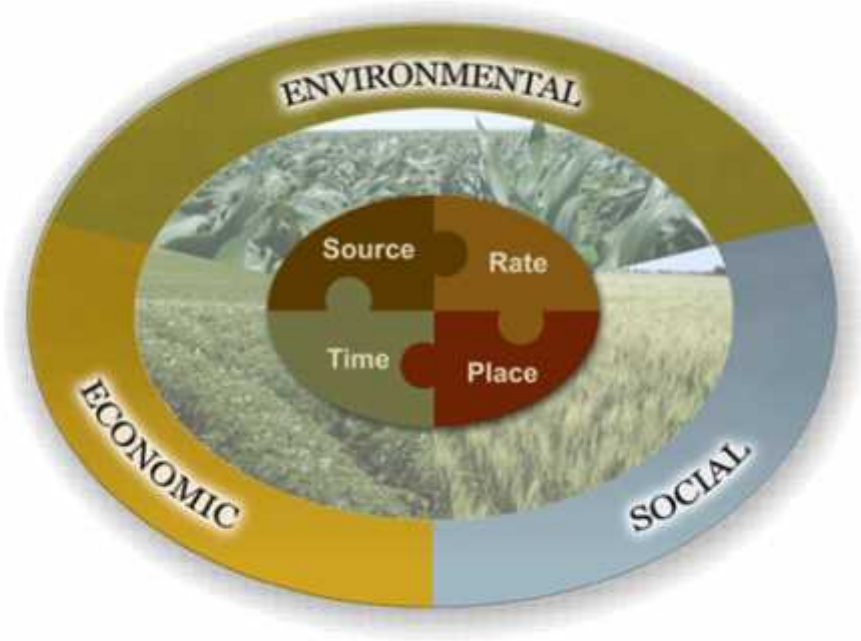
Nitrogen deficiency accounts for 60-95% of maize yield gaps

Complex variability in smallholder farming systems



Giller, 2006

Can crop productivity increases be achieved while achieving high N use efficiencies?



4R Nutrient Stewardship

- Concept developed by the global fertilizer industry
- Balanced application of all 4Rs is required for effective nutrient use
- Provide a basis assessing best management practices of nutrients
- Simple and participatory approach based on concrete scientific principles
- Global principles, adaptable to local conditions

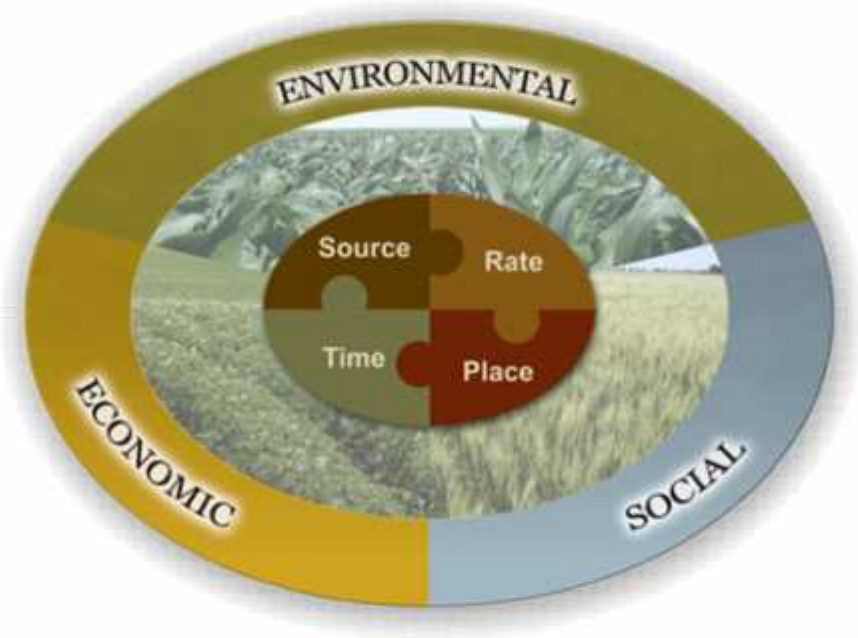
2) Study focus

4R assessment of maize production systems with a focus on nutrient interactions under variable soil fertility

Can crop productivity increases be achieved with high N use efficiencies in SSA?

- Assess effects of inherent and management induced soil variability on maize yields and nutrient use efficiencies.

- Evaluate the long-term effects of nutrient management strategies on maize yields and nutrient use efficiencies



3) Methodology: Study area and field sites

Clay		Sandy	
Standard	Degraded	Standard	Degraded
+ 5 t manure/ha	X	+ 5 t manure/ha	X
+ 50 kg N/ha		+ 50 kg N/ha	
SOC – 1.4%	SOC – 0.8%	SOC – 0.7%	SOC – 0.3%

3) Methodology: Trial design and measurements

Treatments

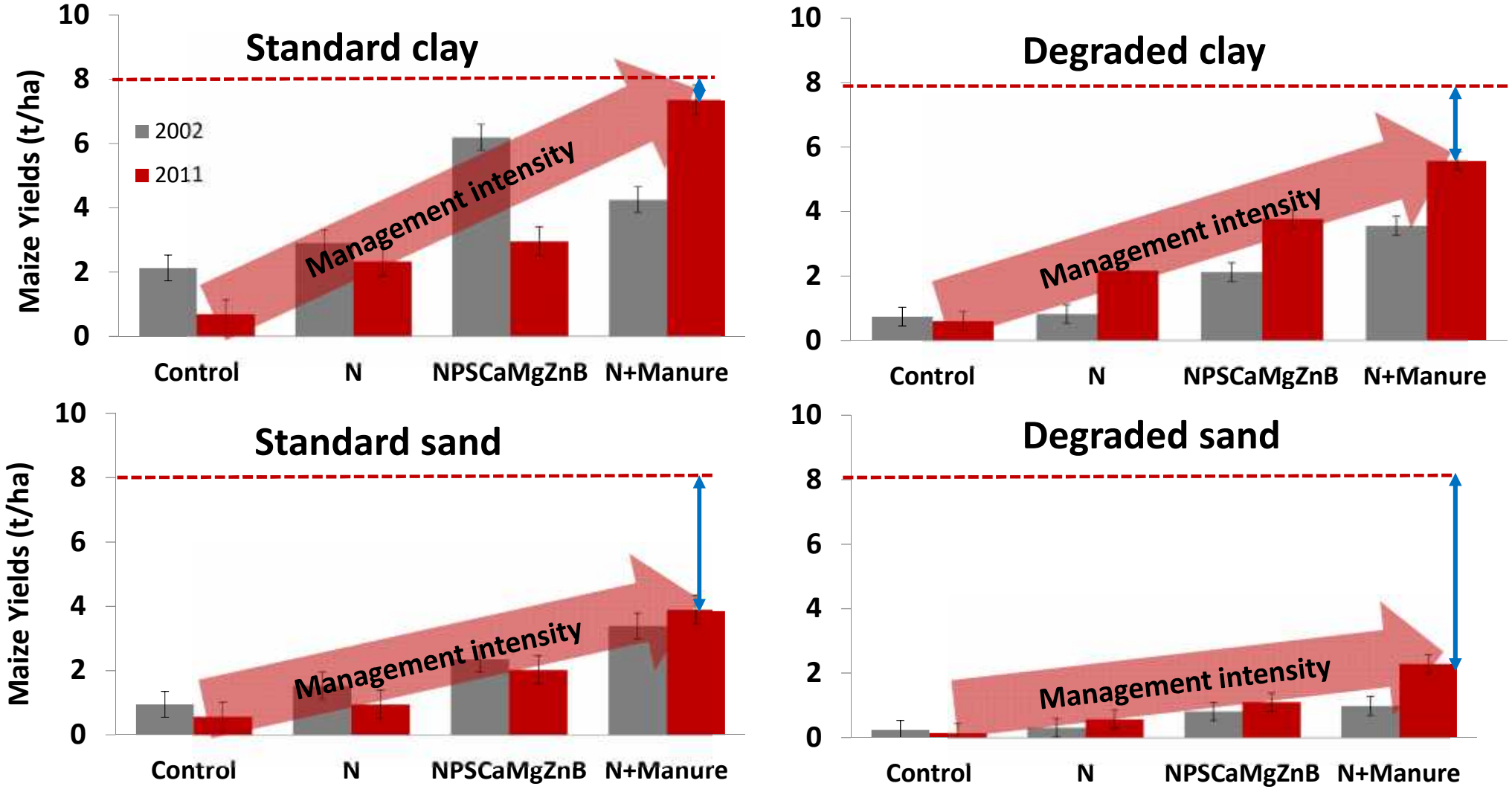
- Control
- 100 kg N/ha
- 100 kg N/ha + PKSCaMgZnB
- 100 kg N/ha + 15 t manure

* Applied for 10 seasons
* Crop residues removed

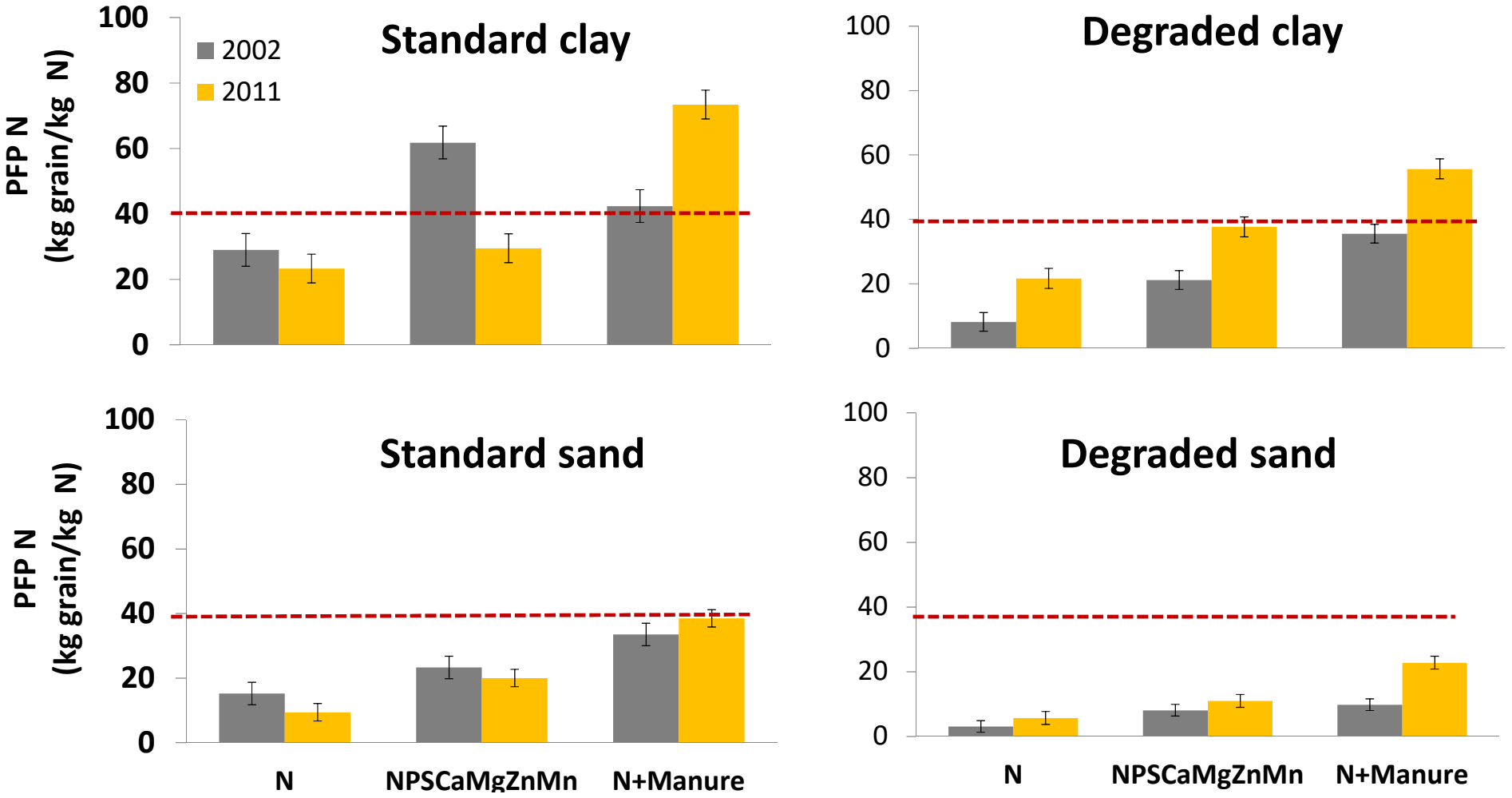
Measurements

- Grain yield
- N partial factor productivity
  [kg grain / kg fertilizer $N_{applied}$]
- Soil properties

4) Results: Maize yield response



4) Results: N Partial Factor Productivity



5) Study highlights

- Maize yields and NUE in SSA strongly affected by soil fertility variability
- Targeted management of N, balanced nutrient application and organic resources required to optimize NUE
- Land degradation impose major challenges for intensification
- Effects of land degradation have long-term effects on yield and N use efficiency
- Integrated soil fertility management as part of a holistic 4R framework crucial for long-term sustainable intensification

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Thank you

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szingore@ipni.net