Sustainable intensification of maize-based systems through improved use of phosphorus fertilizers

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Key messages

- Land degradation, reflected in soil fertility depletion and reduced vegetation cover, is still a major biophysical constraint to sustainable agricultural productivity in Kongwa and Kiteto.
- Targeting nutrient management options to different agro-ecologies is a promising strategy to sustain crop production and to scale the relevant technologies.
- More farmers are realizing that use of fertilizers improves crop yields, even in semiarid sites, when good agronomic practices are adopted.

Objectives and approach

Purpose: Evaluate soil health status and drivers of land degradation (Fig 1) and promote better fertilizer use for sustainable intensification in semi-arid Tanzania.

Approach: Field experiments were carried out to develop phosphorous (P) fertilizer application rate. Baby plot demonstrations were established based on the promising rate for validation and upscaling purposes.

Key results

- Application of 15 - 45 kg P ha^{-1} doubled maize yield relative to the control (Fig. 1). Maize yield increase with fertilizer additions peaked at 30 kg P ha^{-1}, but 15 kg P ha^{-1} is recommended as yield increase after this rate was not significant (Fig. 2). P-use efficiency was improved at a microdose rate of 7.5 kg P ha^{-1} and at 15 kg P ha^{-1} (Table 1).
- Maize response to Minjingu fertilizers in farmers' fields was similar to that of YARA, suggesting that both fertilizer materials can be used by farmers depending on availability and costs (Fig 3).
- Fertilizer use is profitable when site specific rates (15 kg P ha^{-1}) and appropriate crop management practices are used (Table 2).

Significance and scaling potential

- This work contributes to developing fertilizer guidelines in semi-arid Tanzania as there are no fertilizer recommendations for this agro-ecology.
- Over 600 farmers in Kongwa and Kiteto have noted yield benefits due to the use of fertilizer and there high promise to expand the technology to more farmers in these districts.
- Strategic partnership between public private sector and communities is needed for scaling out. This is being investigated in phase II.

Table 1: Phosphorus use efficiency in Kongwa and Kiteto

P rates (kg ha^{-1})	Phosphorus Use Efficiency (%)		
	Moleti	**Mlali**	**Njoro**
0	0.000a	0.000a	0.000a
7.5	5.691b	12.47b	4.966a
15	4.370ab	7.275a	4.177a
30	5.447ab	4.74ab	2.055a

Partners

We thank farmers and local partners in Africa RISING sites for their contributions to this research. We also acknowledge the support of all donors which globally support the work of the CGIAR centers and their partners through their contributions to the CGIAR system

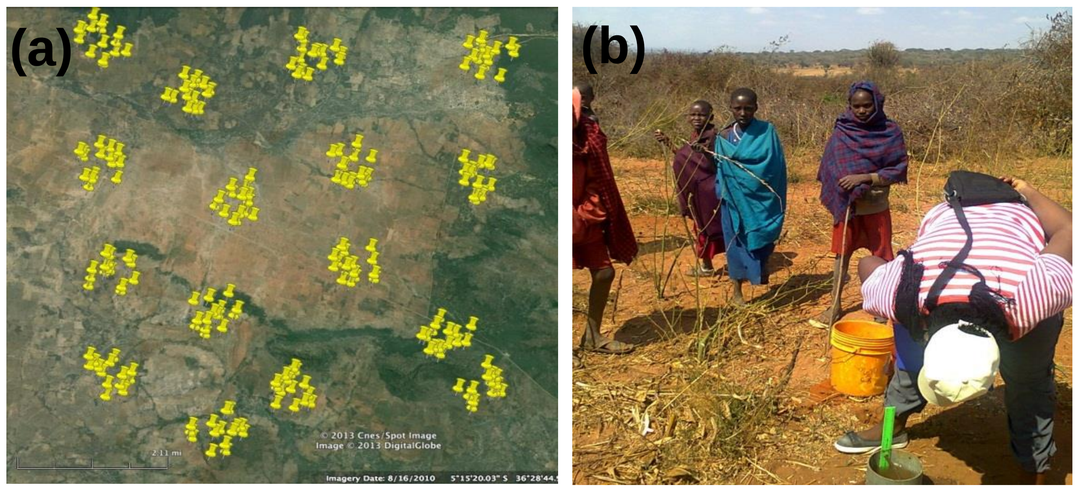

Fig. 1: (a) Google map of the sentinel site in Njoro (Kongwa district), **(b)** infiltration measurement.

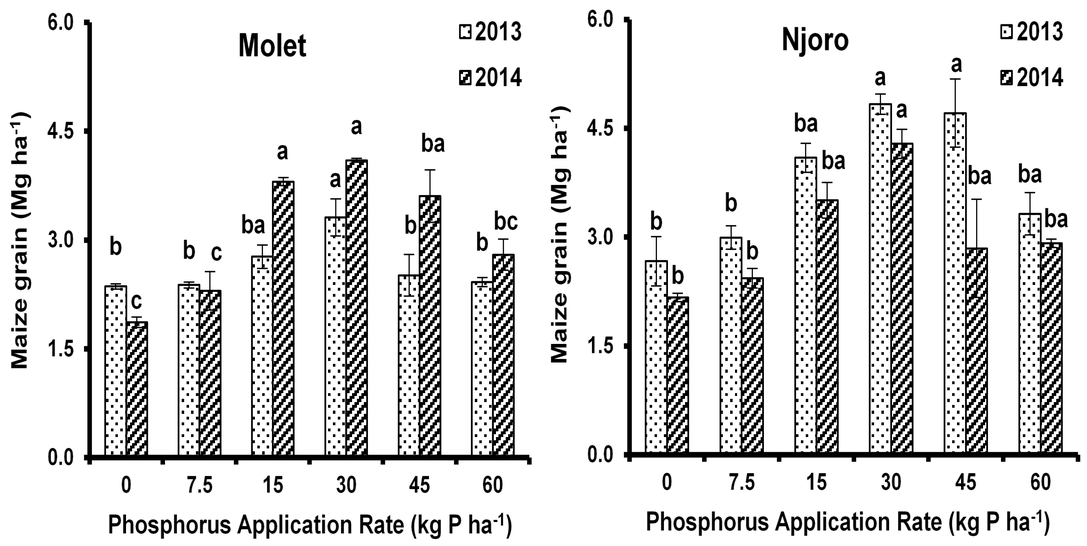

Fig. 2: Maize grain yield response to fertilizers in mother sites in Kongwa and Kiteto Districts, Tanzania. Nitrogen was applied at 60 ha^{-1} in all plots except control.

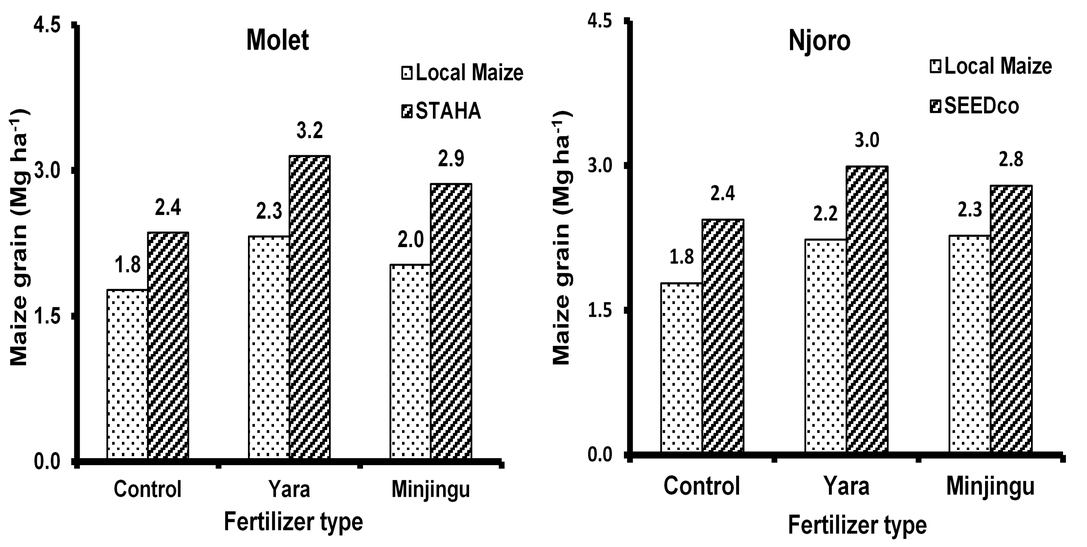

Fig. 3: Maize grain yield response to fertilizers baby plots (n=275) in Moleti and Njoro (Kongwa and Kiteto Districts), Tanzania. P was applied at 15 ha^{-1} and N at 60 ha^{-1}.

Rate (kg P ha^{-1})	Moleti (low rainfall)		Njoro (high rainfall)	
	2013	**2014**	**2013**	**2014**
0	1.41a	1.14c	1.57ba	1.31ba
7.5	1.24a	1.20c	1.53ba	1.27ba
15	1.31a	1.75a	1.86a	1.62a
30	1.33a	1.62ba	1.88a	1.69a

Table 2: Cost Benefit Ratio of P-Fertilizer in Moleti and Njoro