The Impact of Integrated Soil Fertility Management Practices (ISFM) on Dry Grain Yields of Teff, Wheat, Maize and Faba bean of Small-scale Farmers in the Ethiopian Highlands

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Introduction

- With a rapidly growing population, Ethiopia needs to increase food production by at least one million metric tons, in grain equivalent
- Soil degradation is a major production constraint in the highlands and caused by:
  - Soil erosion: 137 tons ha^{-1} yr^{-1}
  - Low soil organic matter content: < 5% in the topsoil
  - Soil acidity: 6 million ha (43% of agricultural land); 3 million ha strongly acidic (pH < 5.5)
- Continuous cropping, residue removal, little and unbalanced fertilizer inputs and lack of knowledge about ISFM are contributing to low soil productivity
  - National Ø yields: wheat 2.7 tons ha^{-1}, maize 3.9 tons ha^{-1}, teff 1.7 tons ha^{-1} and Faba bean 2.1 tons ha^{-1}

Objectives

- To assess impact of ISFM on productivity of crops

Methods

- The project was implemented in 42 districts in Amhara, Oromia and Tigray regions from 2016 to 2018
- ISFM techniques include:
  - 1) improved seed, 2) line seeding, 3) organic amendments (compost/vermicompost, green manure and farmyard manure), 4) inorganic fertilizer, 5) Faba bean with rhizobia and 6) lime in acidic soils
  - Combinations of locally-tested and adopted technologies were used (lime is key and necessary in acidic soils)
- Activities were implemented through participatory on-farm demonstrations
  - Two-plot design (ISFM and farmer practice)
- Approaches used for learning and extension:
  - Community-level participatory planning and evaluation
  - Farmers field school (FFS)
  - Famers research and extension group (FREG)
- Number of sampled demonstration fields: 1252
- Data was analyzed following a linear mixed model fit by restricted maximum likelihood using R package lme4
  - Years and districts were used as random factors

Results

- In non-acidic soils, grain yields were increased by 61% for teff, 53% for wheat and maize, and 60% for Faba bean (P ≤ 0.01) (Figure 1).

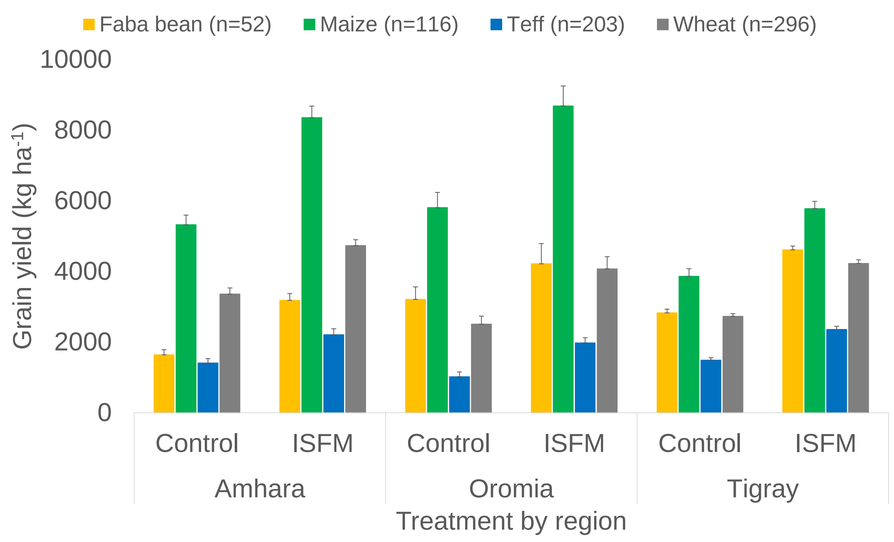

Figure 1: Impact of ISFM on grain yields in non-acidic soils

- In acidic soils, the grain yields were increased by 73%, 69%, 81% and 96% respectively for teff, wheat, maize and Faba bean (P ≤ 0.01) (Figure 2)

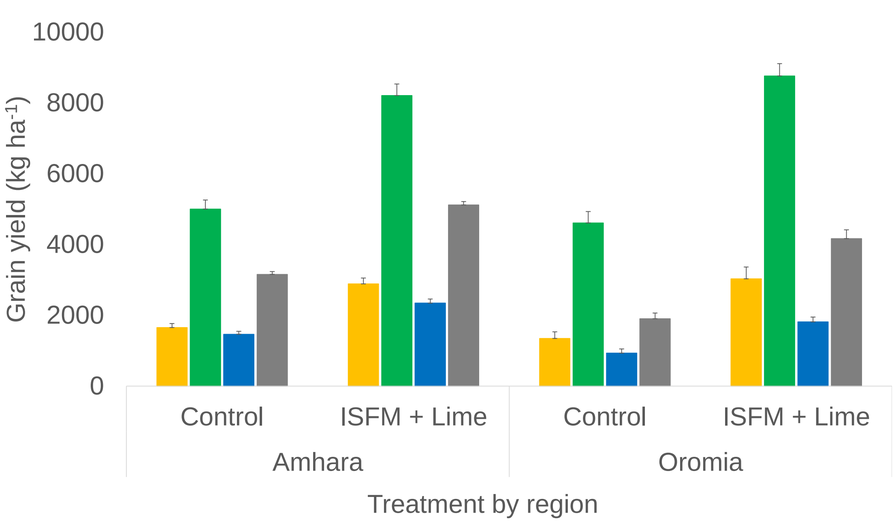

Figure 2: Impact of ISFM on grain yields in acidic soils

Conclusion

- Simultaneous use of ISFM technologies showed significant synergistic effects in improving productivity of crops
- Application of lime is a prerequisite to utilize potential benefits of ISFM technologies in acidic soils
- Facilitating learning and farmer-to-farmer extension through FFS and FREGs enhanced adoption of ISFM (by 240,000 farmers across the regions)
- The ISFM approach is being institutionalized in the national and regional extension packages
- ISFM approach is important to maintain soil fertility and ensure sustainable agricultural production and food security in the highlands of Ethiopia

Acknowledgments

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