Soil suitability for sustainable intensification in smallholder systems in Sub-Saharan Africa

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Background and Objectives

• Providing food and water security for a population expected to exceed 9 billion by 2050 while conserving natural resources requires achieving high(er) and stable yields on every hectare of currently used arable land suitable for intensification.
• Especially relevant for Sub-Saharan Africa (SSA), where 80% of the food is currently produced by smallholder farmers and production is not keeping pace with population growth.
• Other aspects to food security than production alone (Fig. 1); efficiently increasing production on existing farmland forms an essential component of the sustainable intensification paradigm.
• Production systems extremely diverse in terms of agro-ecological and socio-economic conditions: no ‘silver bullet’ but rather ‘best fit’ approach from a basket of options (Table 1, Giller et al., 2011)
• Degraded and poorly responsive soils cover large parts of SSA and represent the majority of poor farmers’ fields.
• Need for a robust method to identify soils suitable for sustainable intensification. Suitable = soils that support resource-efficient and cost-effective responses to ‘interventions’ and not prone to degradation under intensified cropping.
• Combination of soil suitability mapping based on the latest soil data available from AfSIS (ISRIC, 2013) and S-World with spatially explicit methodologies for yield gap assessment currently developed in the Global Yield Gap Atlas project (GYGA, www.yieldgap.org).

Methodology

Proposed soil index for suitability/responsiveness:
• ‘Inherent’ soil properties contributing to yield potential:
  - Water Holding Capacity (~texture, bulk density, SOM)
  - Rooting depth not limiting
  - Slope (runoff/erosion) not limiting
• Properties that are, in principle, amenable to modification:
  - Soil fertility/health
  - Measure of physical and chemical degradation + (Ir)reversibility (pH, salinity, toxicity, ...)
• Latest soil property data and maps from AfSIS (ISRIC, 2013) and S-World
• Combined with high stable Yp/w and climate zone upsampling from GYGA (Fig. 2)

Results

• Crop growth simulations, upscaled with the GYGA climate zonation (Fig. 2), and local data on actual yields, soils and cropping systems give indication about yield gaps, potential yield and stability over time.
• Overlaying soil suitability index with yield gaps will identify zones where (lack of) soil quality can explain a large part of the yield gap.
• High soil suitability with large stable yield gap = high potential for sustainable intensification.

References


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