

# Africa RISING Early Wins Project Proposal

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## **Regionalizing Fertilizer Rate Recommendation for Wheat-Teff Production systems in the Ethiopian Highlands**

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### **Summary:**

This proposal aims to promote sustainable intensification of wheat-teff production systems in the Ethiopian Highlands by providing soil series-specific fertilizer recommendations through soil fertility trials based on newly developed soil maps from partner organizations.

### **Background:**

Rain-fed agricultural areas of East Africa are often food insecure due to rainfall variability and ongoing soil degradation that negatively impacts crop yields. Developing better soil management and/or tillage systems coupled with improved agronomic fertilizer recommendations could potentially increase crop yields of the major food crops. Site-specific sound fertilizer recommendations are especially important given the high cost associated with fertilizers at the port let alone once transported to the agricultural areas. Improved fertilizer use efficiency and determining economically optimum yields fulfills an objective of sustainable intensification.

Healthy crops have access to soil that has an active supply of balanced nutrients. Crop plants are living indicators of the status of the overall soil physical, chemical, and biological environment. Plants thrive under ideal conditions, struggle under sub-optimal conditions, and die when exposed to sustained hostile conditions. The ability of plants to naturally resist or overcome biotic stresses is limited by the weakest component of the plant's response mechanisms. Soils depleted of organic matter and with poor structure due to compaction or excessive tillage will have an impaired ability to supply water and nutrients to crop plants. Conversely, soils in good physical condition have aggregates and pores that are conducive to optimal root growth and, with sufficient soil organic matter, have the ability to infiltrate and store the maximum amount of plant available water. Providing high yield potential crops with adequate fertilization generally helps ensure healthy root systems that will improve soil structure, pore space, and soil water relations. In the Ethiopian highlands, the Ethiopian Institute of Agriculture Research (EIAR) is currently conducting fertilizer trials to examine the impact of different blends of fertilizers but not of fertilizer application rates. Proposed activities in this concept note will engage EIAR specialists and to complement their efforts by generating new data on the spatial patterns of yield response to fertilizer application and economic returns using crop models calibrated with the best available

field trial data. This improved understanding of the spatial patterns of impact will be translated into proposals for regionally-tailored fertilizer recommendations that would replace the current national blanket recommendations. Better matching fertilizer application recommendations to local climate, soil, and management practices helps ensure that production can be intensified in a cost-effective and sustainable way and, thereby, enhance regional food security.

This research will integrate farming systems and build partnerships between ATA, EIAR, IFPRI, the University of Tennessee, and the SANREM CRSP.

**Objective: Determine soil-specific optimum N, P, K fertilizer rate for teff and wheat in the Ethiopian Highlands.**

**Activities:**

- In early April we will have a short planning meeting at ATA to look at the regions' legacy soil maps and corresponding data and compare to the new maps generated by the efforts of AfSIS and ATA. Once we reach consensus on the soil types common to the project target regions we will spend one week minimum at each site evaluating and ground truthing the new soil maps.
- From an intrinsic soil fertility standpoint, we propose to take the three most productive and two of the least productive soil "series" in the target region and verify through ground truthing that the new high detail soil map is correct.
- Soil fertility trials will be conducted on these five selected soil types at five locations located within the project area in the Ethiopian Highlands.
  - At each location we will use the same five rates of N, P and K (but not as a factorial) with four reps and use the old blanket fertilizer recommendation for the basal application of the other two nutrients. This data would provide 25 sites with each site having 60 actual plots (5 N x 4 reps + 5 P x 4 reps) for both wheat and teff, using 10m by 10m plots.
  - Following the April meeting plots will be laid out and fertilizer applied just prior to planting wheat and/or teff in early June. Plots will be harvested in September, if mature grain yields will be measured; else plant biomass will be measured and converted to grain yields.
- Results from the soil fertilizer responses will be analyzed and used to estimate the soil series-specific, versus old blanket, fertilizer recommendations for the sustainable intensification of wheat and teff in the study region.

**Outputs:**

Data can be generated from the groundtruthing week in April to evaluate the actual precision and accuracy of the new soil mapping technologies. Fertilizer rate plots will be in place before the next crop planting date which occurs after the belg season (short rainy season from February to May) and in time for the kiremt rains (long rainy season from June to September). Depending on harvest date, actual yield data could be available by 30 September 2012. If it is too early to harvest grain we will harvest crop biomass and use common conversions to estimate grain yields.

Results from this study will have regional implications as we look at the impact of both soil fertility and soil management systems on the larger food security and climate issues. This research has the potential to benefit farmers and researchers throughout the region as we address these common smallholder and subsistence farming issues that impede regional intensification of food production, both on the subsistence and commercial scales.

**Timeline (2012):**

<i>April</i>	<i>May</i>	<i>June</i>	<i>July</i>	<i>August</i>	<i>September</i>
Initial Planning meeting, groundtruthing & site selection	Plot layout and fertilizers applied	Crop growth rates monitored and measured	Crop growth rates monitored and measured	Data summarized prior to harvest	Harvest of either plant biomass or grain; final report submitted with future fertilizer recommendations

**Lead Partner:** IFPRI (contact: Samuel Gameda, Jawoo Koo, and Stanley Wood)

**Personnel:**

- ATA (Gameda and Girma) will provide new and old soil maps and descriptions of the project sites.
- ATA (Gameda and Girma) will provide host country transport and arrange accommodations and meeting sites
- EIAR (Debele and two researchers) will provide guidance on the overall design of trials
- IFPRI (Koo and Wood) will provide programmatic assistance including reporting and budgetary oversight
- Drs. Eash, Walker (University of Tennessee; SANREM) , Gameda, Girma (ATA), and Debele (EIAR) will do initial mapping and field reconnaissance to determine field research sites.
- The University of Tennessee will provide GPS expertise (Prather) who will also determine precision and accuracy of the new maps.
- All investigators will participate in the harvest in September (including a college student worker).