Decision support tools for farm-level fertilizer recommendation in Ethiopia

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Briefing meeting
Background

- Ethiopian agriculture is very old, traditional

- Low-input, Low-output

- Characterized by Nutrient mining
  - Soil erosion for centuries
  - Limited input application (18 kg ha-1)
  - Limited nutrient recycling (e.g. manure for cooking, plastering)

- Diverse in altitude, agroecology, food habit

- Agronomical Inefficient, low productivity per unit of land, labour, water
ATA did a very good job in developing site specific fertilizer recommendation:

Confluence points and our sites
Soil fertility status of Tigray
ATA Fertilizer recommendation for Southern Tigray: too fragmented, difficult to operationalize
Identifying Nutrient Management Zones

✓ Fields are a mosaic of habitats, each having unique biophysical characteristics that influence soil properties and crop yields.

✓ The effectiveness of matching fertilizer types to soil fertility problems rests on the ability to identify limiting factors, characterize sites, and develop appropriate recommendations.

✓ Approaches for identifying nutrient management zones require collection and interpretation of spatial data (yield, elevation, RS, electrical conductivity, soil nutrient maps, and Farmers’ classification criteria).
Farming systems of Ethiopia

Amede et al., 2015
Appreciating diversity; Wheat systems
Nutrient Zonation within the Wheat systems
Our research (240 farmers fields) shows three types of responses to application of various fertilizer combinations
EndaMehoni
Footslope. Good Crop, No effect of blends

- Crop is doing well but there is no visible difference among our treatments in terms of growth, height and vigour;
- Our treatments are not even better than farmers plots;
- This is where agronomic management played more than nutrient application.
Midslope farms. Distinct difference among treatments

Major effect from NP, and in some case K or S
Hillslope. Bad crop, no difference, lost investment (Non-responsive soils)

No visible yield margin for the investment
Crop response to fertilizer blends, Enda-Mehoni (Midslope and Hillslope)

![Bar chart showing the wheat grain yield (t ha⁻¹) for different fertilizer blends on fertile and marginal soils. The groups compared are Control, 33%NP, NP, NPK, NPKS, and NPKSZn. The chart indicates a significant increase in yield with fertilizer application, with NPK and NPKS blends showing the highest yields on both fertile and marginal soils.]
Zonation in DBirhan

Footslope

Midslope

Hillslope
Crop response to fertilizer blends, Dbirhan (Footslope and Midslope)

![Graph showing wheat grain yield under different fertilizer treatments for fertile and marginal soils.](image-url)
Net benefits of fertilizer application

Figure-1: Distribution of Net Benefit by Treatment Group and Soil Strata

Net Benefit per Ha (thousands of Birr)

0 8 16 24 32 40 48 56 64 72

0.33NP  NP  NPK  NPKSZn  NPKSZn  NPKSZn  NPKSZn  NPKSZn  NPKSZn  NPKSZn  NPKSZn  NPKSZn

dberhan  Endame  Lemo  Sinana

Hillslope  Midslope  Footslope
### Zinc and Protein as affected by blends, Endamehoni

<table>
<thead>
<tr>
<th></th>
<th>Protein (%)</th>
<th>Zinc (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers' Control</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>33%NP</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>NP</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>NPK</td>
<td>a</td>
<td>b</td>
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<tr>
<td>NPKS</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>NPKSZn</td>
<td>a</td>
<td>a</td>
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</tbody>
</table>

**Legend:**
a: Significantly different from control
b: Different from control

**Note:** Values followed by different letters are significantly different.
Zinc and Protein as affected by blends, Lemo

2D Graph 2

- **Zinc (mg kg⁻¹)**
  - 0
  - 4
  - 8
  - 12
  - 16
  - 20
  - 24
  - 28
  - 32
  - 36
  - 40

- **Protein (%)**
  - 0
  - 4
  - 8
  - 12
  - 16
  - 20
  - 24
  - 28
  - 32
  - 36
  - 40

**Fertilizer Blends:**
- 33%NP
- NP
- NPK
- NPKS
- NPKSZn

**Legend:**
- Black bars: Protein
- Gray bars: Zinc

**Annotations:**
- a, b, c indicate significant differences among fertilizers.
Calcium as affected by blends (confounding effect?)

<table>
<thead>
<tr>
<th>Blends</th>
<th>Calcium (g kg⁻¹)</th>
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<tbody>
<tr>
<td>33%NP</td>
<td></td>
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<tr>
<td>NP</td>
<td></td>
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<tr>
<td>NPK</td>
<td></td>
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<td>NPKS</td>
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<tr>
<td>NPKSZn</td>
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</table>

The chart shows the calcium content for different blends, with Mehoni and Lemu treatments indicated. The data points are marked with letters (a, b, c, d) to indicate significant differences.
What does it mean?

- Crop productivity is dictated not only by soil fertility but also climate, crop type, slope, management etc.
- Fertilizer recommendation should be based on comprehensive analysis of cropping systems;
- There are similarities between agricultural fields, located in different parts of the region or country, demanding similar treatments
- Instead of Kebele/woreda based recommendation the need to consider system based fertilizer recommendation
- Agronomic and Economic efficiency needs to be assessed for fertilizer recommendation
- Aggregated decisions could be made with system-based recommendations
Initiatives towards Nationwide Approach

- EIAR invited ICRISAT/Africa RISING to share experiences
- March, 2016: National Task Force that would revisit the current approaches and recommendations created;
- National Task Force include various institutions; including ATA, EIAR, Universities (Mekelle, Hwassa), MoANR; CG
- May 20, 2016. ATA and EIAR called a meeting to
  a) Rethinking approach, using Africarising experiences;
  b) Distilling key technologies/ recommendations for extension; with timeline..
- Attracted huge interest from various groups (GiZ, Teagasc-Ireland, Nebraska University, CG centres, LandMark EU)
Next steps

- Validating our model in other two major cropping systems (Maize/Teff based and Sorghum-based systems) in major regions; also with high value crops, with higher returns;
- Assembling and re-analysing the available country wide ATA data, based on top-sequence/cropping system/soil types
- Through our national taskforce, and together with the ATA, EIAR and MoANR develop **Farmer friendly tool for efficient use of inputs**, country-wide
- Through Regional RARIs, Strengthen our Policy dialogue with the regions and lobby for change in approaches across the regions
Thank You

Africa Research in Sustainable Intensification for the Next Generation

africa-rising.net
Our treatments
(Optimal nutrient applications?)

- NP (90/45)
- NPK (90/45/61)
- NPKS (90/45/61/63)
- NPKSZn (90/45/61/63/10)
- Minimum application (30% recommended NP)
- Farmer’s fields (control)