Conclusions and recommendations

The Optimizer is an innovation that considers the money the farmer has available to invest in fertilizer. It helps the resource-constrained farmers to make decisions on the most profitable crop-nutrient combination so as to get maximum return. The FOT is an innovation that has the potential to improve both incomes and food security for resource-constrained smallholder farmers. [See monograph 3 for supporting evidence.]

Generally there is lack of awareness amongst smallholder farmers of the 4 Rs of fertilizers (right source; right rate; right time and right place) and also of other integrated soil fertility management (ISFM) strategies to increase crop yields. Awareness raising campaigns to support the introduction of FOT should therefore include the roles of fertilizer in the context of ISFM and the potential returns on investment.

The Uganda versions of the FOT consider only maize, sorghum, upland rice, soybean, groundnut and beans. There is demand to update it to include more crops, and also incorporate other ISFM components, such as benefits of a legume in crop rotation and other fertilizer types. This requires responsive functions obtained from either new trials or existing data. The current FOT is an Excel tool that runs on a computer. There is therefore the need to circulate the paper-based version of the FOT.

Acknowledgement

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Links with additional information

2. Uganda work positioned to make fertilizer use more profitable for poor farmers [http://bit.ly/1RCl1c8]

Monograph series:

These monographs can be downloaded from www.africasoilhealth.cabi.org

For further information contact Harrison Rware, M.A & specialist OFRA project, CABI [h.rware@cabi.org]

Monograph 1: Fertilizer Optimization Tool, an innovation for resource poor farmers in Africa

Monograph 2: Individuation of the Fertilizer Optimization Tool, a key ingredient to sustainability lessons from Uganda

Monograph 3: Farmers start appreciate the benefits of using the Fertilizer Optimization Tool in guiding fertilizer application in Uganda

Monograph 4: Fertilizer Optimization Tool: From the community knowledge and extension workers perspective in Uganda (following up on trained intermediaries)

Integrating ISFM approaches

Nutrient substitution look-up table (being developed and will be available soon) is used to adjust the output of the FOT to take into account other integrated soil fertility management (ISFM) practices the farmer is using that impact on nutrients supply.

The ISFM practices to be included in the look-up table are the use of various types of organic matter (manure, compost, crop residues), intercropping and rotations with legumes, fallows and the results of selected soil tests. For each practice, the table suggests how the fertilizer recommendations generated by the FOT should be adjusted; for example, for every one tonne of farmyard manure (dry matter) applied per acre, fertilizer equivalent to 4 kg urea, 2 kg DAP and 2 kg MOP could be spared.

Integrated soil fertility management: Substitution for fertilizer nutrients

<table>
<thead>
<tr>
<th>ISFM Practice</th>
<th>Urea</th>
<th>DAP or TSP</th>
<th>MOP</th>
<th>NPK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous crop was green manure</td>
<td>100%</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>Fresh vegetative material applied per tonne of fresh material</td>
<td>6 kg</td>
<td>2 kg</td>
<td>2 kg</td>
<td>8 kg</td>
</tr>
<tr>
<td>Farmyard manure per 1 tonne of dry material</td>
<td>5 kg</td>
<td>3 kg</td>
<td>2 kg</td>
<td>10 kg</td>
</tr>
<tr>
<td>Residual value of farmyard manure applied for the previous crop, per 1 tonne</td>
<td>2 kg</td>
<td>1 kg</td>
<td>1 kg</td>
<td>3 kg</td>
</tr>
<tr>
<td>Dairy or poultry manure, per 1 tonne dry material</td>
<td>9 kg</td>
<td>4 kg</td>
<td>5 kg</td>
<td>16 kg</td>
</tr>
<tr>
<td>Residual value of dairy or poultry manure applied for the previous crop, per 1 tonne</td>
<td>2 kg</td>
<td>2 kg</td>
<td>1 kg</td>
<td>3 kg</td>
</tr>
<tr>
<td>Compost per 1 tonne</td>
<td>8 kg</td>
<td>3 kg</td>
<td>3 kg</td>
<td>15 kg</td>
</tr>
<tr>
<td>Residual value of compost applied for the previous crop</td>
<td>3 kg</td>
<td>2 kg</td>
<td>1 kg</td>
<td>5 kg</td>
</tr>
<tr>
<td>Rotation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No reduction but expect more yield</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercropping cereals-Bean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase DAP/TSP by 7 kg/acre – but no change in N &amp; K, compared with sole cereal crop</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercropping cereals-legumes (effective in N fixation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase DAP/TSP by 11 kg/acre, reduce urea by 9 kg/ha, and no change in K</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If (ti + BI &gt; 3) parts per million</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply 0 P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If soil test K = 100 parts per million</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Band apply 20 kg/acre mixture of potash in band or point placement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*If barley and teff are already abundant, they should be considered for use but planting them is discouraged as it is an invasive weed species.

Figure 6: Current recommendations for Uganda
The optimization process using the FOT

There is a stepwise process followed to optimize fertilizer allocation and application using the FOT. These processes consider the income a farmer wants to invest in purchasing fertilizer and works on Liebig's law.

The Crop Selection and Prices table shows the range of crops for which reliable data on fertilizer response functions has been amassed. The farmer is asked to assess what the value of the grain will be at harvest time or planned point of sale.

The Crop Selection and Prices table gives options for the most common fertilizers on sale in the region, where necessary additional fertilizer options can be added as new products become available.

The Crop Selection and Prices table shows the expected grain value ($ ha\(^{-1}\)) and the minimum and maximum amount available to invest.

The Crop Selection and Prices table provides the density of the nutrient or fertilizer blend. New fertilizer blends can be added by the user.

The fertilizer optimization diagram

The FOT is an innovation to help farmers optimize returns on their investment in fertilizer by selecting the best crop-nutrient combination.

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