Farmer Decision Making Strategies for Improved Soil Fertility Management in Uganda and Mozambique

Robert Mazur¹ (Lead PI)
Richard Miiro²  Venâncio Salegua³  Eric A Abbott¹  Ebby Luvaga¹

¹ Iowa State University, ² Makerere University, ³ Mozambique Agricultural Research Institute

Pan African Grain Legumes and World Cowpea Conference
Livingstone, Zambia
Feb. 28 – Mar. 4, 2016
Partner Institutions & Co-PIs

- **Iowa State** (R. Mazur, A. Lenssen, E. Luvaga, E. Abbott, L. Burras)
  - Sociology, Cropping Systems, Soils, Economics, Communication

- **University of Hawai`i** (R. Yost)
  - Tropical Plant & Soil Sciences

- **University of Illinois** (J. Bello Brava, B. Pittendrigh)
  - Communication, Scientific Animations Without Borders

- **Makerere University, Uganda** (M. Tenywa, R. Miiro)
  - Agricultural Production, Soils, Extension & Innovation Systems

- **National Agric. Research Laboratories Uganda** (O. Semalulu)
  - Soils, Environment & Agro-Meteorology

- **Mozambique Agric. Research Institute** (R. Maria, V. Salegqua)
  - Soils, Bean Breeding, Socioeconomics, Training and Technology Transfer, Outreach/Extension/Communication

Partner Institutions & Co-PIs

- **Iowa State** (R. Mazur, A. Lenssen, E. Luvaga, E. Abbott, L. Burras)
  - Sociology, Cropping Systems, Soils, Economics, Communication

- **University of Hawai`i** (R. Yost)
  - Tropical Plant & Soil Sciences

- **University of Illinois** (J. Bello Brava, B. Pittendrigh)
  - Communication, Scientific Animations Without Borders

- **Makerere University, Uganda** (M. Tenywa, R. Miiro)
  - Agricultural Production, Soils, Extension & Innovation Systems

- **National Agric. Research Laboratories Uganda** (O. Semalulu)
  - Soils, Environment & Agro-Meteorology

- **Mozambique Agric. Research Institute** (R. Maria, V. Salegqua)
  - Soils, Bean Breeding, Socioeconomics, Training and Technology Transfer, Outreach/Extension/Communication
**Project Rationale**

- **Common beans** serve **important roles** in **cropping systems**, **food security**, **nutrition**, **incomes**, and **livelihood resilience** – but **low yields**, **pervasive poverty** and **food insecurity**.

- ‘**Sustainable intensification**’ of agriculture production requires **improved soil fertility management** in which **legumes** are an **integral part** of cropping systems.

- **Poor and declining soil fertility** is a **key constraint to increased common bean productivity**; there is limited adoption/use of improved production practices.

- **Addressing soil-related constraints** requires understanding farmers’ current practices and **enhancing their capabilities in diagnosing and finding solutions** to yield constraints.
Research Project Objectives (1,2,3)

- Characterize smallholder farmers’ key goals and motivations, current knowledge/practices, problem diagnoses, and livelihood and risk mgmt. strategies

- Develop and refine models of their decision-making

- Develop and validate appropriate [visual] diagnostic and decision support aids
Develop and assess the effectiveness of innovative approaches for dissemination of information and decision support aids, training, and follow-up technical support \[1225\]

...to stimulate widespread and sustainable implementation of improved site-specific crop system & soil fertility management input decisions
Research Sites

Masaka & Rakai districts

Gurúè district
Altitude 750-1200m, Annual Rainfall 1000-1500mm

Soils for beans vary by season (type, location in landscape)

Chemical and Physical Properties
- texture, pH, organic matter, available nutrients, aluminum

Nutrient Omission Study (NOS) [1309]
- Predominant soils for bean growing (vis. color & texture)
- Provide all required nutrients ‘minus one at a time’
- N, P, K, Ca, Mg, Zn, Fe, B

Lime Requirement Study (LRS) [1208]
- Low pH, Ca and Mg availability, and Al toxicity
- Limestone sources being developed
Crop production & soil fertility improvement are complex knowledge mgmt. processes in dynamic context of livelihood priorities and resources.

Understanding farmers’ motivations, current knowledge & practices in bean crop systems [1194]

- Field selection (vis. soil characteristics and fertility)
- Variety selection (vis. yield, biotic constraints, cooking and taste attributes, market price)
- Rotation and intercropping
- Planting methods and spacing, weeding timing
- Inputs used (manure, inorganic fertilizer & sprays)
- Problem diagnoses and solutions adopted to date
- Local methods of monitoring/evaluating experiments
Soils and Crops Research

- Comparing Bean Production Systems
  - Replicated research done on-farm; 2-3 soil types / site
    1 - Conventional Farmer System
    2 - Improved Farmer Systems based on NOS and LRS
    3 - Researcher Developed High Input System [1182]
    4 - Organic and Inorganic Fertilizer Comparisons [1031]
  - Include *long established* and *new/improved bean varieties* ( tolerant/resistant of specific soil infertility conditions and fungal and bacterial pathogens)

- Soils Mapping (being integrated for better assessments)
  - USDA Soil Taxonomy & FAO World Reference Base
  - Farmers’ local/indigenous classifications [1201]
  - *Improved interpretive value to farmers* and others
Participatory Approach & Methods

- On-farm studies to identify possible solutions
  - Practices and soil amendments based on *observable indicators* and *available materials*
  - Soil type and site-specific management options/strategies

- *Local farmer knowledge systems and experiences in experimentation and innovation* combined with *scientific analyses* of soil-related constraints

- Community-based field trials of promising options [1220]

- Development and pilot-testing of innovative socio-technical approaches to communication & dissemination
  - Participatory radio, text and audio SMS
  - Animated videos in local languages on cell phones
Factors in Decision Making

- **Livelihood Goals and Resources** for production and marketing (natural, physical, financial, human, social)
- **Heterogeneity** of households: land size and tenure, income sources, access to markets, extension services
- **Gender** vis. priorities, negotiating resource use decisions
- **Market** development and access [1108]
- **Information** sources and perceived credibility (extension services - government and private sector, media)
- Availability (local or reliable input system), affordability, *multifunctionality, observable results, compatibility* [1222]
- Farmer and community-based organizations (emerging multistakeholder ‘innovation platforms’ – farmers, input dealers, credit providers, traders, extension agents) [1234]
<table>
<thead>
<tr>
<th>Community-level INDICATORS</th>
<th>Uganda</th>
<th>Mozambique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate Food Supply (in past year)</td>
<td>32%</td>
<td>34%</td>
</tr>
<tr>
<td>Food Insecurity (no food past 4 weeks)</td>
<td>13%</td>
<td>32%</td>
</tr>
<tr>
<td>Land Insecurity Concerns</td>
<td>21%</td>
<td>24%</td>
</tr>
<tr>
<td>Hired Labor</td>
<td>45%</td>
<td>21%</td>
</tr>
<tr>
<td>Livestock</td>
<td>93%</td>
<td>33%</td>
</tr>
<tr>
<td>Sold Beans (past 12 months)</td>
<td>64%</td>
<td>85%</td>
</tr>
<tr>
<td>Non-Agricultural Income</td>
<td>48%</td>
<td>67%</td>
</tr>
<tr>
<td>Savings</td>
<td>66%</td>
<td>57%</td>
</tr>
<tr>
<td>Credit Accessible</td>
<td>75%</td>
<td>53%</td>
</tr>
<tr>
<td>Borrowed Money</td>
<td>46%</td>
<td>9%</td>
</tr>
</tbody>
</table>
Household-level Patterns

Uganda: (preliminary analysis)
- **Manure** (11%) + Older, Acres, Hire Labor, Savings, Credit Access
- **Fertilizer** (35%) + Younger HHH, Acres, Group, Hired Labor, Livestock, Sell Beans, Non-Ag. Income, Savings, Credit, Borrow
- **Pesticide** (33%) + Younger HHH, Male, Acres, Hire Labor, Land Insecurity, Non-Agric. Income, Savings, Credit Access
- **Herbicide** (20%) + Group, Sell Bean, Hire Labor, Land Insecurity, Credit

Mozambique: (preliminary analysis)
- Manure, Fertilizer, Herbicides = use levels too low to analyze variation
- **Pesticide** (26%) + 2 Adults (vs. 1, 3), NO Hired Labor, Food Security, NOT Land Insecure, Non-Agric. Income, NOT Savings, NOT Credit Access
<table>
<thead>
<tr>
<th>Decision Maker %</th>
<th>Husband</th>
<th>Both</th>
<th>Wife</th>
<th>Husband</th>
<th>Both</th>
<th>Wife</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Area</td>
<td>13</td>
<td>38</td>
<td>28</td>
<td>34</td>
<td>57</td>
<td>6</td>
</tr>
<tr>
<td>Which Field</td>
<td>11</td>
<td>39</td>
<td>30</td>
<td>39</td>
<td>53</td>
<td>5</td>
</tr>
<tr>
<td>Varieties</td>
<td>11</td>
<td>37</td>
<td>32</td>
<td>36</td>
<td>55</td>
<td>5</td>
</tr>
<tr>
<td>Plant When</td>
<td>11</td>
<td>37</td>
<td>31</td>
<td>35</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>22</td>
<td>37</td>
<td>23</td>
<td>45</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>Chemicals</td>
<td>24</td>
<td>39</td>
<td>20</td>
<td>48</td>
<td>41</td>
<td>6</td>
</tr>
<tr>
<td>Hire Labor</td>
<td>14</td>
<td>38</td>
<td>25</td>
<td>50</td>
<td>42</td>
<td>5</td>
</tr>
<tr>
<td>Qty. Sell</td>
<td>17</td>
<td>38</td>
<td>25</td>
<td>38</td>
<td>52</td>
<td>6</td>
</tr>
<tr>
<td>Use Bean $</td>
<td>14</td>
<td>40</td>
<td>26</td>
<td>25</td>
<td>42</td>
<td>28</td>
</tr>
</tbody>
</table>

Note: does not include data for Female Heads of Household, ~20% in Ug., 4% in Moz.
Decision Making Considerations

Uganda – *more* land borrowing, leasing, purchasing; women’s role prominent; hired labor; livestock; savings, credit, borrowing

Mozambique – community land delimitation process increased land registration/titling

Titling and manure for more secure and better quality soils

Land *in*security concerns are common in both countries

Differences btw. Uganda and *Mozambique* (land abundant, lower level of economic pressure on land - but rapidly changing)

Purchased inputs with economic ability in Uganda; manure & fertilizer on more secure land; pesticides/herbicides on less secure

Limited purchased inputs in Mozambique; more analysis needed

Research continues on decision making models and application