RAISING CROP RESPONSE:
Bidirectional learning to catalyze sustainable intensification at multiple scales

Sieg Snapp, Freddy Baijukya, Mateete Bekunda, Ken Giller, Neema Kassim, Thom Jayne, Nicky Mason, Judith Odhiambo, Jean Claude Rubyogo and Hamisi Tindwa

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Project goal

- To improve family nutrition, reduce poverty, and enhance use of environmentally-sound farming practices among smallholder farmers in East Africa
Project objectives

1. To generate improved agronomic knowledge of practices that sustainably raise maize and bean yields and crop response to inorganic fertilizer

2. To evaluate bidirectional learning and effective extension approaches to promote SI technologies among researchers, extension, agrodealers, NGOs, and farmers

- **Bidirectional learning**: an iterative, participatory process by which information providers (extension, agrodealers, and NGOs), researchers, and farmers fine-tune recommendations
3. To generate improved knowledge of the nutrition impacts of adoption SI technologies through analysis of Tanzania household surveys

4. To provide practical guidance to governments on staple food marketing, trade, and extension policies that support adoption of OM/SI technologies to support broader diffusion and scaling, and to work synergistically with activities under Obj. 1-3
Objective 1: Maize response

1. Survey of 600 households/maize fields across Southern and Northern highlands, to quantify crop yield, legume presence, soil properties and document farmer practices.

2. Partners: CIMMYT (TAMASA Project - BMGF), SARI, Uyole Research Staff, MSU Agronomists and Ag Economists.
Obj 1. SIIL/CIMMYT TAMASA Agronomic Panel Survey locations

624 households surveyed in 25 districts
Objective 1: CIMMYT/SIIL survey
Unique features of this dataset

- Comprehensive data on:
  - Household characteristics, farm-level management data
  - Additionally, for focal maize plot:
    - Detailed agronomic mgt questions (including 5 yrs mgt history)
    - Yields (based on crop-cuts) & Drone monitoring in 2018
    - Soils data
    - GPS location and area measurement

- High-frequency panel
  - Revisit each household and plot every year
  - Insights into inter-seasonal variability of mgt & productivity outcomes
Labile Carbon POXC (mgC/kg soil) 584 +/- 288
Research question: Soil C threshold maize fertilizer response?

Zambia Soil Organic Matter Threshold = 1.2%

Average product of fertilizer (Maize yield response)

Burke et al., 2016
Objective 1: Legumes and soil

1. Measuring soil impact of legume crops (bean, pigeonpea and lablab) in long-term trials

2. Partners: Sokione Univ., Wageningen Univ., SARI, IITA, MSU.

1. Three PhD students - all have started courses (at SU, WU and MSU) Said Hamad; Esther Mugi; Ali Nord

2. Two of the students have started measurements in long-term maize-legume trials underway in Tanzania
Objective 1: Quantifying soil C, N

Lablab
(Lablab purpureus)

W. Mariki, N. Miller, A. Nord, S. Snapp and team
Objective 1: Legumes and soil
Objective 2: Research on Extension
Objective 2

A scalable extension model - FIPS works through village-based agricultural advisors (VBAAs)

1. VBAAs are selected by community members:
   - farming experience
   - competency in record keeping
   - ability to train other farmers,
   - to follow up on FIPS activities
   - interest in business to supply ag inputs

2. Training:
   - Agronomy (Bean seed treatment with input from Uyole, Syngenta (Apron star seed treatment), FIPS)
   - Participatory training to improve farmer engagement, use of mother and baby demos, drama
## Objective 2

<table>
<thead>
<tr>
<th>District</th>
<th>Dates</th>
<th>Village Based Advisors VBAA Trained</th>
<th>Farmers Advised</th>
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<tbody>
<tr>
<td>Iringa</td>
<td>January 23-24</td>
<td>24</td>
<td>4,800</td>
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<tr>
<td>Mufindi</td>
<td>January 25-26</td>
<td>30</td>
<td>5,940</td>
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<tr>
<td>Makambako</td>
<td>January 27-28</td>
<td>25</td>
<td>5,048</td>
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<tr>
<td>Njombe</td>
<td>January 30-February 2</td>
<td>49</td>
<td>9,751</td>
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<td>Songea</td>
<td>February 3-4</td>
<td>29</td>
<td>5,807</td>
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<td>Mbozi</td>
<td>February 6-7</td>
<td>29</td>
<td>5,815</td>
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<td>Mbeya</td>
<td>February 8-9</td>
<td>30</td>
<td>5,880</td>
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<td><strong>TOTAL</strong></td>
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<td><strong>216</strong></td>
<td><strong>43,041</strong></td>
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VBAA Training: Hands on learning
FIPS works VBAAs Certified by Tanzania Extension

1. **VBAAs are lead farmers, selected by communities**

1. **Mother and baby demos:**
   - *mother demo* setup by VBAA to show improved varieties, inputs (bean varieties, with and without fertilizer, seed treatment)
   - *baby demos* VBAA advises ~200 farmers and provides small packs of inputs

3. **We are testing if ‘baby demos’ farmer involvement improves extension**
Mother and baby trial design

Snapp et al., 2002
Mother demo: VBAA teaching tool
Does addition of baby demos improve extension? Improve VBAA advise?
Objective 2: Research on Extension

- 108 VBAAs **Mother demos** on bean varieties, fertilizer and Apron star seed treatment
- 108 VBAAs **Mother demos + baby demos** (~200 farmers provided seed and Apron star)

All VBAAs trained on farmer participatory extension, learning by doing and fine-tuning extension advise

Monitoring of VBAA performance, advice given and inputs sold, profit, and farmer adoption
Objective 2

Iringa: Mother demo and baby demo (+/- Apron star treated bean varieties)
Objective 2

1. Baseline and endline survey

2. Monitoring log

<table>
<thead>
<tr>
<th>Farmer Name</th>
<th>Phone</th>
<th>Bean Variety</th>
<th>Seed dressing</th>
<th>Advised?</th>
<th>Baby demo?</th>
<th>Hands on training?</th>
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### Objective 2

3. VBAA effectiveness at extension advisors and input providers

4. Monitoring log

<table>
<thead>
<tr>
<th>VBAA Name</th>
<th>Phone</th>
<th>Seed sold</th>
<th>Inputs sold (fert., seed trt)</th>
<th>Costs</th>
<th>Profit</th>
<th>Advice provided</th>
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## Objective 3: Nutrition & SI Adoption

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<tr>
<th>Fert.</th>
<th>Manure</th>
<th>Maize-Ppea/Lab</th>
<th>Maize-Legume</th>
<th>NPS Survey 2012/13</th>
<th>SI Rank</th>
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<td>(45.38%)</td>
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<td>(7.43%)</td>
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<td>X</td>
<td>(18.80%)</td>
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Does SI adoption affect nutrition outcomes?

- And if so, via which pathway(s)?

**Figure. Conceptual Pathways Between Agriculture and Nutrition**

- **National Economic Growth**
- **National Nutrition Profile**

Key components of the enabling environment:
- Food market environment
- Natural resources
- Health, water, and sanitation
- Nutrition/health knowledge and norms

Source: Herforth and Harris (2014)
Nutrition indicators

- **Children under 5**: height-for-age (stunting), weight-for-age (underweight), weight-for-height (wasting)
- **Women of reproductive age (15-49)**: body mass index
- **HH**: dietary diversity (DD) – measure of food access (not nutrition per se)
SI indicators by domain – Overview

**HUMAN CONDITION & ECONOMICS** Objective 3 SI adoption, Nutrition & Profit (Tanzania rural household representative survey)

**ECONOMICS, ENVIRONMENT & PRODUCTIVITY** Objective 1, Profit, Maize/bean yield, response to fertilizer, soil organic matter, biological N fixation, Nutrient budgets (Southern and northern highlands, 600 household survey, soil and plant sampling with CIMMYT, UW, SUA, MSU students)

**SOCIAL & ECONOMICS** Objective 2, Extension and farmer capacity, Gender equity and profit (Babati case study and 224 village based advisors extension approach with Africa RISING IITA, CIAT, and an NGO FIPS, Tanzania extension and UYOLE scientists)

**ALL DOMAINS:** Local study 3 districts, focus groups linked to surveys, to explore tradeoffs and synergies, nutrition, food security, income, capacity, SI farming system practices and biodiversity

SIIL Output
Objective 4 Policy recommendations
SIIL Output
Example from Malawi:
SI technology performance

- Maize yield (max 5000 kg/ha)
- Maize residue production (max 10,000 kg/ha)
- Maize yield stability (max 1.6)
- Legume residue production (max 10,000 kg/ha)
- Legume yield (max 860 kg/ha)
- Gross margin per ha (max $800)
- Months of soil cover (max 12)
- Soil carbon % change over 25 yrs (min = -12%, max = +12%)
- Soil N % change over 25 years (min = -15%, max = +15%)
- Probability of 100% needs met (max = 100%)
- Probability of 200% needs met (max = 100%)
- % females preferring (max = 100%)

Snapp et al., ms sub.
SI technologies identified that perform well in multiple domains (environment, economic, production, social and human/nutrition)

Quantify soil N and C contributions of legume crops

Effective extension approaches documented (do baby demos and VBAAs deliver?)

Policy recommendations that improve maize-bean response to inputs
Raising crop response