Integrated systems research for farms and livelihoods in Africa RISING phase II

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Systems approach

- Larger-whole implications
- Interactions among components
- Multifunctionality of components and system

- Portfolio of methods
- Multidisciplinary
- Boundary objects
  - Experiments, models
  - Research products
  - Design tools: SI framework, impact pathways, influence diagrams
Influence diagram (example boundary object)

- Soil properties
- Erosion
- Topography
- Biomass
- Ground cover
- Fodder species
- Inputs (e.g. fertilizer)
- Water supply
- Herd mgt
- Land allocation
- Adoption
- Labor availability
- Herd size
Portfolio of methods (examples)

- On-station and on-farm experiments
- Participatory
  - Focus Group Discussions; interviews; livelihood analysis
  - Participatory mapping; resource flow maps; transect walks
  - Problem trees; Appreciative Inquiry; Most significant change
  - Co-innovation, project management
- Farm analysis and redesign
  - Farm surveys, typologies
  - Crop, animal and environmental simulation
  - Farm and landscape modeling
- Scaling approaches
Systems and integration

- **System:**
  - Limited part of reality
  - Interacting components
  - Delineation

- **Integration:**
  - What does the research result mean at the **target** system level?
  - What is the pertinent management unit? → farm / household
AGRO-ECOLOGICAL LANDSCAPE

SOCIO-INSTITUTIONAL LANDSCAPE

Research emphasis

Phase I  Phase II

-  -

-  -

-  -

-  -

-  -

-  -

Institutions
Markets
Businesses
Platforms
Community
Groups
Household
Farmer(s)
Fields, animals
Farms
Landscape
Means- vs. goal-oriented

- Means-oriented:
  - Evaluation of quality of measures and techniques at field and farm level
  - Often labeled “sustainable” a-priori

- Goal-oriented:
  - Comparison of the productive, environmental and social performance
  - Using a set of explicit goals, made operational through indicators (MF)
  - Different spatial and temporal scales and organization levels

- Focus on the outcomes (goals), that can be reached by different system configurations and implemented measures and techniques
Trade-offs at system level

- When improving the system for one goal, another goal can be compromised (ex. F1 = profit, F2 = soil quality i.r.t. livestock)
- Evaluate trade-offs in terms of goals at the target system level
- Often there are multiple ways to reconfigure to reach goals

Best guess scenarios

Single objective optimization

Pareto-based optimization
Ex. Trade-offs between multiple goals
Ex. Goals for HHs (1): Labor/leisure time

<table>
<thead>
<tr>
<th>Labor balance</th>
<th>Regular</th>
<th>Casual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm management</td>
<td>800</td>
<td>0</td>
</tr>
<tr>
<td>Crop management</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>Herd management</td>
<td>730</td>
<td>0</td>
</tr>
<tr>
<td>Available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired labor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Own labor</td>
<td>3200</td>
<td>0</td>
</tr>
<tr>
<td>Balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surplus</td>
<td>1634</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th>Labor input per gender and age class</th>
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</thead>
<tbody>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fraction of labor per gender and age class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family labor</th>
<th>Available time</th>
<th>Farm labor</th>
<th>Off-farm labor</th>
<th>Leisure time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3200</td>
<td>1566</td>
<td>1600</td>
<td>34</td>
</tr>
</tbody>
</table>

- Farm labor balance
- Gendered labor distribution
- Household labor allocation
Ex. Goals for HHs (2): Budget

<table>
<thead>
<tr>
<th>Household budget</th>
<th></th>
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<tbody>
<tr>
<td><strong>Household size</strong></td>
<td></td>
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<tr>
<td>Number of household</td>
<td>5</td>
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<tr>
<td><strong>Income</strong></td>
<td></td>
</tr>
<tr>
<td>Farm income</td>
<td>42201</td>
</tr>
<tr>
<td>Off-farm income</td>
<td>73980</td>
</tr>
<tr>
<td>Total income</td>
<td>116181</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Costs for food</td>
<td>35672</td>
</tr>
<tr>
<td>Other expenditures</td>
<td>60000</td>
</tr>
<tr>
<td>Total expenditures</td>
<td>95672</td>
</tr>
<tr>
<td>Proportion food costs</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>Financial result</strong></td>
<td></td>
</tr>
<tr>
<td>Free budget</td>
<td>20509</td>
</tr>
</tbody>
</table>

- On and off-farm income
- Expenditures, food and other
- Available free HH budget
Beyond trade-offs: integrative solutions

- Try to identify solutions to problems that overcome trade-offs and avoid compromise
- Integrative solutions require insight into whole-system responses to different forms of use and an overview of services provided

- Example crop residue use:
  - Allocations: as mulch, feed, firewood, building material
  - Goals: improve soil fertility, feed animals, cooking, heating, building
  - Solutions...
Dealing with diversity

- Farms and households differ in:
  - Size and structure (farm, HH)
  - Development stage (HH)
  - Goals and constraints (HH)

- Distributions: overview of the ranges and variation
- Typologies: grouping of diverse population into similar types

- Farms/HHs with different characteristics need different solutions
Trajectories of change

- How to attain goals in a sequence of changes?
- Different pathways (sequences of solutions) for different farm/HH types
Conclusions

- Evaluate research outcomes in the context of the target system
- Focus on the goals of farms and households, how to attain these
- Explore the system-level trade-offs, look for integrative solutions
- Identify the trajectory (-ies) to follow to reach the ultimate goals
- Accommodate diversity in farm and household structure and goals
- Embrace a portfolio-approach combining multiple methods
Thank You

Africa Research in Sustainable Intensification for the Next Generation

africa-rising.net
Ex. Farm configuration
### Ex. Goals for farms (1): Nutrient yield

Yield is expressed as the number of people (consumer units) that can be sufficiently nourished for a given nutrient.
Ex. Goals for farms (2): Operating profit
Sustainable by design (example boundary object)

- Is it good for the environment?
- Do all HH members have access to resources?
- Are farmers safe in making and using their products?
- Are people treated the same?
- Do men and women paid the same for the same job?
- Do farm operations contribute to environmental quality?
- Is the farm productive without causing degradation?
- Is it profitable?
- Do farmers and workers get a living wage?
Scholarship on boundary work is rapidly expanding (6, 7, 11, 12). In general, it hypothesizes that boundary work is more likely to be effective in promoting used and useful research to the extent that it exhibits at least three key attributes: (i) meaningful participation in agenda setting and knowledge production by stakeholders from all sides of the boundary; (ii) governance arrangements that assure accountability of the resulting boundary work to relevant stakeholders; and (iii) the production of “boundary objects,” defined as collaborative products such as reports, models, maps, or standards that “are both adaptable to different viewpoints and robust enough to maintain identity across them” (13).

**Boundary objects.** ASB created a variety of boundary objects that were jointly “owned” by natural and social scientists. One of the first of these was the development of shared protocols for data collection developed to guide and coordinate work across the ASB benchmark sites (27, 28). There was little truly interdisciplinary scholarship involved in this work. However, the commitment of natural and social scientists to contribute their respective parts to a common whole clearly advanced mutual understanding and respect. Real interdisciplinary integration eventually followed, perhaps most clearly illustrated by the bioeconomic models developed by ASB and its partners from Brazil’s Embrapa (29). These models