Sustainable intensification tradeoffs and synergies

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Farming systems in Africa have complex interactions

Africa RISING – research to intensify production sustainably
What does it mean for agricultural intensification to be sustainable?
How do we know if we are making progress?

- Research in Development
- Natural Resource Base for Agriculture
- Ecosystem Services from Agriculture

- Food security
- Nutrition
- Health

- Income

- Agricultural Production
- Change in Agricultural Practices

- Collective Action
- Conflict Resolution
- Women’s Empowerment
Five domains of Sustainable Intensification

- Social
- Economic
- Human condition
- Environment
- Productivity
How do we know if we are making progress?

- Research in Development
- Natural Resource Base for Agriculture
- Ecosystem Services from Agriculture
- Change in Agricultural Practices
- Agricultural Production
- Income
- Food security
- Nutrition
- Health
- Collective Action
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- Change in Agricultural Practices
<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>EXAMPLE INDICATORS</th>
<th>SCALE</th>
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<tbody>
<tr>
<td>Productivity</td>
<td>Yield</td>
<td>Landscape/Administrative</td>
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<td></td>
<td>Fodder production</td>
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<td>Yield variability</td>
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<td>Yield gap</td>
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<td>Economic</td>
<td>Profitability</td>
<td>Farm/Household Scale</td>
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<td>Input use efficiency</td>
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<td></td>
<td>Variability of profitability</td>
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<tr>
<td>Environmental</td>
<td>Plant biodiversity</td>
<td>Field/Animal Herd Scale</td>
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<td>Nutrient balance</td>
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<td>GHG Emissions</td>
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<tr>
<td>Human Condition</td>
<td>Nutrition</td>
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<td></td>
<td>Food Security</td>
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<td></td>
<td>Health</td>
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<tr>
<td>Social</td>
<td>Equity (gender &amp; marginalized groups)</td>
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<td></td>
<td>Level of collective action</td>
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<td>Conflicts over resources</td>
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Three primary uses of the SI indicator framework

1. Identifying tradeoffs and synergies
2. Assessing technologies
3. Monitoring and evaluation of community-wide impact
Why are trade-offs important?

• Multiple objectives for land use
• Limited resources
• Conflicting objectives of stakeholders

(Klapwijk et al. 2014)
What do you think of?

“Trade-offs related to sustainable intensification”
Examples of trade-offs

• Within a domain
  • Land for legumes vs. Land for maize

• Across domains
  • Crop residues – Fodder vs. Soil fertility
  • Input use - Production vs. Pollution

• Across spatial scales
  • Farm profitability → agricultural expansion → habitat loss

• Across time
  • Near term production sacrifice for long term stability

• Across groups in a typology
  • Crop growers vs. Herders
There are synergies as well

- Fertilizer use may stimulate production that leads to improved carbon cycling
- Multi-purpose legumes can build soil fertility and provide a source of nutritious food
- Push-pull systems like Desmodium and Napier grass can help control maize stem borers and provide soil benefits (nitrogen, cover, Striga suppression)
<table>
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<th>Productivity</th>
<th>Environment</th>
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<tr>
<td>Crop production</td>
<td>Vegetative cover</td>
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<td>Fodder production</td>
<td>Plant biodiversity</td>
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<tr>
<td>Animal production</td>
<td>Fuel availability</td>
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<td>Variability in production</td>
<td>Water availability</td>
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<td>Water quality</td>
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<tr>
<td>Equity of marginalized groups</td>
<td>Income diversification</td>
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<td>Returns to land, labor and capital</td>
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<td>Conflicts over resources</td>
<td>Poverty rates</td>
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<td>Market participation</td>
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Human condition
- Nutritional status
- Nutrition awareness
- Food security
- Capacity to experiment
- Human health

Environment
- Vegetative cover
- Plant biodiversity
- Fuel availability
- Water availability
- Water quality
- Soil erosion
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- Nutrient partial balance
- Greenhouse gas emissions
- Pesticide use

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Draw arrows for connections
- Use +, ++, or +++ to show synergies
- Use -, --, or --- to show tradeoffs
Trade-offs Exercise

- Look at Enset (False Banana)
Example baseline diagram for Enset (false banana) in Ethiopia – notice the negative effect on gender equity due to high female labor requirements in processing.

**Project Name:** SII Intensification Ethiopia

**Research focus, objective, and scale:** Improve Enset management practices and productivity at the household scale (Baseline)

**Social**
- Gender equity
- Age equity
- Equity of marginalized groups
- Level of social cohesion
- Level of collective action
- Conflicts over resources
- Prestige in community

**Productivity**
- Yield
  - Fodder production
  - Animal productivity
  - Cropping intensity
  - Variability in production

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**Economic**
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- Variability of profitability
- Income diversification
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- Limitations to land, labor and capital
- Poverty rates
- Market participation
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Draw arrows for connections

Use +, ++, or +++ to show synergies

Use -, --, or --- to show tradeoffs
Example diagram of intended changes from Enset intervention – mechanization to reduce female labor, agronomics to improve production and market linkages to improve profits.

**Project Name:** SIIIL Intensification Ethiopia

**Research focus, objective, and scale:** Improve Enset management practices and productivity at the household scale (Scenario)

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Malawi – Africa RISING example
Production of nutritious food ≠ Nutrition outcomes

- Training on agriculture-nutrition linkages:
- “Introduction to nutrition-sensitive programming”
- https://agrilinks.org/sites/default/files/nutrition-training/module1part1/index.htm
The Pathways Model for Agriculture-Nutrition Linkages

Agricultural Program or Policy

- Agricultural Production
- Women's Control of Productive Asset and Resources

- Income
  - Food Expenditures
  - Non-Food Expenditures

- Women's Time Allocation
  - Female Energy Expenditure

Storage and Processing

- Household Food Access & Consumption
  - Adequate Diet
    - Energy & Protein
    - Micronutrients

- Health Services
- Caring Practices
  - Health Status

Child Nutritional Status
Women's Nutritional Status
Gender issues cut across all domains

- Reflect on the following questions:
  - Will the use of the technology affect women’s access to resources (land, money, household labor)?
  - How will the technology affect women’s time differently from men?
  - How does the technology address women’s priorities vs. men’s priorities?
  - What are possible negative side effects of the technology for women?
Hemminger, K., Bock, B., Groot, J., Michalscheck, M., Timler, C., 2014. Towards integrated assessment of gender relations in farming systems analysis. MSc thesis - Wageningen University (also presented as a poster with the co-authors at Tropentage 2014)
Methods for Trade-off analysis

- Participatory research methods
  - Resource flow mapping; Participatory scenario development
  - Games and role plays; Fuzzy Logic Cognitive Mapping
- Empirical analyses - Experiments
- Simulation models
- Optimization models – detailed further in Kanter et al. 2016


Questions?

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Thank You

Africa Research in Sustainable Intensification for the Next Generation

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