Productivity, environmental impacts and tradeoffs of livestock intensification options in Tanga region, Tanzania

10th of December 2015, 3rd Tanga Dairy Stakeholders’ platform meeting

Birthe Paul, An Notenbaert, Catherine Pfeifer, Joanne Morris, Julius Bwire, Amos Omore – and many more contributors

b.paul@cgiar.org
Presentation outline

1. Potential environmental impact assessment
2. Forage technologies and productivity
3. Conclusions
Livestock’s environmental impacts are widely discussed.
Farmers often face tradeoffs, eg between production and environment.
They influence adoptability, impact and sustainability of interventions.
There is no one silver bullet, capturing diversity is key.
Modeling needed to assess potential impacts (what-if).
Ex-ante impact assessment can provide decision support.
Environmental impacts along the value chain

1. Water availability and quality
   • Available water

2. Soil and land health:
   • Soil erosion
   • Soil fertility

3. GHG emissions:
   • Methane, nitrous oxide, carbon dioxide

4. Biodiversity loss:
   • Species diversity

Long-term sustainability needs to be assessed before designing large-scale livestock development projects. Quick ex-ante environmental impact assessment needed!
Farming systems in Tanga

Participatory GIS workshop in June 2014 in Lushoto
## Scenario parameters

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Feed scenario</th>
<th>Genetics scenario</th>
<th>Animal health scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herd composition:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extensive (e)</td>
<td>84%</td>
<td>84%</td>
<td>84%</td>
<td>76%</td>
</tr>
<tr>
<td>Semi-intensive (si)</td>
<td>16%</td>
<td>16%</td>
<td>16%</td>
<td>24%</td>
</tr>
<tr>
<td><strong>Herd size increase</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>+80%</td>
</tr>
<tr>
<td><strong>Liveweight increase</strong></td>
<td>0% (e)</td>
<td>+7% (e)</td>
<td>+29% (e)</td>
<td>+14% (e)</td>
</tr>
<tr>
<td></td>
<td>0% (si)</td>
<td>+6% (si)</td>
<td>+11% (si)</td>
<td>+6% (si)</td>
</tr>
<tr>
<td><strong>Milk yield increase</strong></td>
<td>0% (e)</td>
<td>+25% (e)</td>
<td>+50% (e)</td>
<td>+31% (e)</td>
</tr>
<tr>
<td></td>
<td>0% (si)</td>
<td>+12% (si)</td>
<td>+4% (si)</td>
<td>+12% (si)</td>
</tr>
<tr>
<td><strong>Feed basket %:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>natural pasture</td>
<td>(e)</td>
<td>(e)</td>
<td>(e)</td>
<td></td>
</tr>
<tr>
<td>maize residue</td>
<td>51</td>
<td>41</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>planted fodder</td>
<td>49</td>
<td>39</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>maize bran</td>
<td>45</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>oil seed</td>
<td>31</td>
<td>26</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>concentr. hay</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
Greenhouse gases

- Indicated by: carbon dioxide equivalents

- GHG change mainly driven by changing animal numbers
Enteric fermentation - Methane 80%
Manure - Methane 14%
Manure - Methane 2%
Manure - Indirect N2O 2%
Soil - Direct N2O 9%
Soil - Indirect N2O 1%

Carbon stock changes - SOC 4%
Enteric fermentation - Methane 80%

Agropastoralist

Burning...
% change in GHG per milk produced

- Improved breeds
- Improved feeding
- Increased animal health

Agropastoralist

Mixed crop-livestock

N balance per area

- baseline
- Improved breeds
- Improved feeding
- Increased animal health

kg N ha⁻¹
Water use

- Indicated by: crop water use as percentage of rainfall

- Water use driven by milk yield and liveweight – but then by feed types and their yield – so shifting to planted fodder more efficient than natural grazing
Biodiversity

- Indicated by: biodiversity index – percent of IUCN red list species in the area using the location as habitat
Presentation outline

1. Potential environmental impact assessment
2. Forage technologies and productivity
3. Conclusions
Village innovation platforms in Lushoto

- Country level meetings (Dairy Development Forum)
- Regional dairy platform meetings
- District policy making
- Village Innovation Platforms

Dairy development in Tanzania with local innovation platforms: When and how can they be useful?

Barthe K. Paul, Breigize L. Moses, Fred Waswa, Amos O. Onwe, and Geoffrey Bruns

Farmers and livestock keepers in Tanzania face a range of problems including low productivity, limited access to inputs and outputs, animal health and milk and market marketing. Twenty percent of the milk produced in Tanzania is from indigenous East African Shorthorn cattle, which produces an average of 1000 liters of milk per day while improved commercial breeds contributes 30%. At all levels of milk production, farmers face low returns on improved breeds, and most livestock farmers struggle to make ends meet.

Milk productivity in many areas of Tanzania is severely limited by factors such as lack of quality and time of collection, preventing or limiting efforts to ensure such as East Coast fever control and milk deserves and access to markets. Both labor and capital-intensive practices add to the cost of production and quality of milk. Production and quality of milk is also affected by a lack of adequate milk collection systems. The effect of inadequate milk collection in all production systems (livestock, crop, genetics, animal husbandry) mean natural grass and herbal, and commercial milk yields and quality. Milk production is also affected by productivity and quality of the dairy cows. The milk production is highly influenced by the quality and time of collection. The quality and time of collection is influenced by the quality and time of collection. The quality and time of collection is influenced by the quality and time of collection. The quality and time of collection is influenced by the quality and time of collection.

Local innovation platforms are an important tool for learning and change. They are open to all stakeholders from different backgrounds and can learn from diverse sources including farmers, researchers, producers, and officials. They have a unique capacity to diagnose problems and identify opportunities and find ways to achieve their goals. They may design and implement action plans as platforms or coordination activities by individual members.

What role can local innovation platforms play in helping solve these problems? Under what conditions are they useful, and what factors are key to success? Do we need innovation platforms at all levels, or can we work with producer groups? The local innovation platforms can increase access to technology and markets from FAO, a project that aimed to improve the feeding of dairy cows in Tanzania (see 2).
Randomized forage trials
# Soil quality

## Ubiri, Lushoto

<table>
<thead>
<tr>
<th>Bray P mg/kg</th>
<th>Total Nitrogen %</th>
<th>Total Carbon %</th>
<th>Soil organic matter (g/kg)</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1. Addition of P fertilizers: Very low levels indicate acute deficiency &amp; most crops will respond to P fertilizers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Monitoring soil N levels and applying recommended rates of N fertilizer; levels that are too high may leach into ground water causing contamination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Continuing with organic matter application to maintain soil organic matter levels</td>
</tr>
<tr>
<td>AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Mbuzii, Lushoto

<table>
<thead>
<tr>
<th>Bray P mg/kg</th>
<th>Total Nitrogen %</th>
<th>Total Carbon %</th>
<th>Soil organic matter (g/kg)</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1. Addition of P fertilizers: Very low levels indicate acute deficiency &amp; most crops will respond to P fertilizers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Monitoring soil N levels and applying recommended rates of N fertilizer; levels that are too high may leach into ground water causing contamination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Continuing with organic matter application to maintain soil organic matter levels</td>
</tr>
<tr>
<td>AVERAGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Forage experimentation

• Local Napier produced higher biomass than the hybrid, with a clearly higher biomass where manure was applied. Hybrid Napier produced more tillers.
• Biomass was generally higher where Napier was intercropped with Desmodium
• Bachiaria under either manure or Desmodium intercrop did not out-yield either of the Napier provenance
• In conclusion, intercropping with Desmodium with either of the grasses increases the dry matter yield per unit area which, especially under manuring. Therefore, smallholder dairy farmers should preferably grow Napier when intercropped with Desmodium for increased forage productivity.
## Farmer forage experimentation

<table>
<thead>
<tr>
<th>Site</th>
<th>Forages Received in 2014</th>
<th>Women (no.)</th>
<th>Men (no.)</th>
<th>Total (no.)</th>
<th>Forages received from TALIRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ubiri</td>
<td></td>
<td>11</td>
<td>14</td>
<td>25</td>
<td>Napier hybrid, Napier Kakamega II, Greenleaf desmodium, Mulberry and Gliricidia sepium</td>
</tr>
<tr>
<td></td>
<td>End of 2015</td>
<td>38</td>
<td>49</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Mbuzii</td>
<td>Received in 2014</td>
<td>9</td>
<td>19</td>
<td>28</td>
<td>Napier hybrid, Napier Kakamega II, Greenleaf desmodium, Mulberry Canavalia brasiliensis</td>
</tr>
<tr>
<td></td>
<td>End of 2015</td>
<td>9</td>
<td>19</td>
<td>28</td>
<td>(only in demo plot)</td>
</tr>
</tbody>
</table>
Presentation outline

1. Potential environmental impact assessment
2. Forage technologies and productivity
3. Conclusions
Conclusions

- Enteric fermentation is the largest contributor to GHG emissions
- Emission intensities are higher for mixed crop-livestock systems when measured per area, but lower per liter milk produced
- N balances are negative for mixed farming, and positive for agro-pastoralists due to the manure produced by the relatively big herd
- Livestock intensification strategies result in almost all cases in lower emission intensities, especially in the agro-pastoral system
- Improved livestock feeding through planted forages is a promising option, both for productivity (especially under intercropping and manure) and environment
- Further work is done to assess farm and landscape scale tradeoffs between productivity and environmental impacts
Water
Soil
GHGs
Biodiversity

Intensive

Semi-intensive

Extensive

* VC step partly assessed
** VC step not yet assessed

Low impact risk
Slight medium impact risk
Medium impact risk

District boundary
- Other town
- Important river
- Forest

Fodder scarcity dry season