Land requirement to feed a productive dairy cow and a healthy family

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Send a Cow + CIAT learning workshop on most effective land use options for smallholder dairy farmers
Overview

1) Introduction
   - Background SAC-CIAT collaboration
   - Objectives

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   - Selection of sites and case study farms
   - Data collection
   - Data analysis and modeling

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   - Feed gap analysis
   - Milk and total land
   - Land for 1 dairy cow
   - Profitability
   - Labour and economics
   - Environment

4) Scenarios
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   - Feed gap analysis
   - Land for 1 dairy cow
   - Profitability
   - Economics
   - Environment

5) Farmers feedback
   - Positive and negative aspects
   - Challenges
   - Ideas

6) Conclusion and outlook
1) Introduction

- SAC
- SAC - Kenya since 1996
- Empower smallholder farmers through trainings in sustainable agriculture and through gifting livestock and planting material.
- Western Kenya, resource poor farmers, average farm size 1.5 acre

“How much land is needed to feed a productive dairy cow and a healthy family?”

- CIAT- SAC collaboration

- CIAT forage team has expertise in farming systems research and trade-off analysis for fodder production.
Objectives:

• Assess the land requirement for a dairy cow across most relevant farming systems.
• Propose best-bet feeding options.
• Explore trade-offs of these feeding strategies with food vs. feed land requirements, environment, labour and gender equity, and profitability.

Research questions:

• How much land is needed to feed a cow and a family with various best-bet feeding strategies across most relevant farming systems?
• What are the synergies/trade-offs of these feeding strategies with environmental quality (soils and GHG), gender equity, profitability and labor requirements?
2) Methodology - data collection

• Selection of sites and case study farms
  - Western Kenya: Kakamega, Bungoma, Busia and Siaya
  - Selection criteria: administrative boundary, market access, one lactating dairy cow, representativeness
  - 8 representative case study farms (4 counties * remote/accessible)

• On-farm data collection:
  - Empirical data collection
  - Geographical location (GPS)
  - Farmer interview

• Focus group discussions
2) Methodology – data analysis and modelling

• Modelling tool: “CLEANED” calculator
  - inputs: agro-ecology, livestock, feed basket
  - outputs: land requirement, environmental indicators, value of production

• Excel calculations for Feed Gap Assessment

• ArcMAP for farm mapping
## Farm overview

<table>
<thead>
<tr>
<th>FARM ID</th>
<th>COUNTY</th>
<th>LOCATION</th>
<th>MARKET ACESS</th>
<th>PRECIPITATION (mm/yr)</th>
<th>SOIL FERTILITY</th>
<th>HH MEMBER (ADULTS+ CHILDREN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1KN</td>
<td>KAKAMEGA</td>
<td>NEAR</td>
<td>++</td>
<td>(1924) high</td>
<td>high</td>
<td>7+7</td>
</tr>
<tr>
<td>2KR</td>
<td>KAKAMEGA</td>
<td>REMOTE</td>
<td>++</td>
<td>(1895) high</td>
<td>high</td>
<td>2+5</td>
</tr>
<tr>
<td>3BN</td>
<td>BUNGOMA</td>
<td>NEAR</td>
<td>+</td>
<td>(1725) medium</td>
<td>medium</td>
<td>2+5</td>
</tr>
<tr>
<td>4BR</td>
<td>BUNGOMA</td>
<td>REMOTE</td>
<td>-</td>
<td>(1726) low</td>
<td>low</td>
<td>4+6</td>
</tr>
<tr>
<td>5BN</td>
<td>BUSIA</td>
<td>NEAR</td>
<td>+</td>
<td>(1717) medium</td>
<td>medium</td>
<td>5+5</td>
</tr>
<tr>
<td>6BR</td>
<td>BUSIA</td>
<td>REMOTE</td>
<td>-</td>
<td>(1430) low</td>
<td>low</td>
<td>2+4</td>
</tr>
<tr>
<td>7SN</td>
<td>SIAYA</td>
<td>NEAR</td>
<td>-</td>
<td>(1460) HIGH</td>
<td>high</td>
<td>3+4</td>
</tr>
<tr>
<td>8SR</td>
<td>SIAYA</td>
<td>REMOTE</td>
<td>-</td>
<td>(1530) high</td>
<td>high</td>
<td>4+2</td>
</tr>
</tbody>
</table>
3) Baseline results

**GROUP MEMBERS PEAK MILK PRODUCTION**

**GROUP MEMBERS LAND AREA**
Milk production

Estimated annual milk production (L/year)

Milk production (L)/ Lactating cow

Our vision, a sustainable food future
Energy and protein balances

ME requirements (MJ/day) for maintenance+milk production

CP requirements (g) for maintenance+ milk production

Intake ME MJ/day/LU

Intake g CP/day/LU

Dairy meal
Sweet potato - vines
Common Beans- vines
Brachiaria
Sesbania
Sugarcane - tops (green fodder)
Desmodium
Wild Desmodium
Leucaena
Maize - stover
Calliandra
Maize - green fodder
Local mixed grasses

KAKMEGA
BUNGOMA
BUSIA
SIAYA
NEAR
REMOTE
NEAR
REMOTE
NEAR
REMOTE
NEAR
REMOTE
NEAR
REMOTE
Labor and gender implications

Our vision, a sustainable food future
Environmental impact

**N balance**

- Baseline

**GHG emissions**

- Baseline

Our vision, a sustainable food future
4) Scenarios

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>MILK REGIME</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>- HIGH</td>
<td>ANNUAL MILK INCREASE TO 3000 L (15 L/DAY)</td>
</tr>
<tr>
<td>Bracharia</td>
<td>CURRENT HIGH</td>
<td>ALL NAPIER TRANSFORMED INTO BRACHARIA</td>
</tr>
<tr>
<td>2:1 Ratio</td>
<td>CURRENT HIGH</td>
<td>65 % GRASSES 35 % LEGUMES</td>
</tr>
<tr>
<td>Dairy meal</td>
<td>CURRENT HIGH</td>
<td>5 %</td>
</tr>
<tr>
<td>Calliandra</td>
<td>CURRENT HIGH</td>
<td>15 %</td>
</tr>
</tbody>
</table>
Area equivalent

<table>
<thead>
<tr>
<th>MILK incr. %</th>
<th>30</th>
<th>48</th>
<th>41</th>
<th>41</th>
<th>45</th>
<th>43</th>
<th>51</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAND incr %</td>
<td>24</td>
<td>42</td>
<td>39</td>
<td>35</td>
<td>34</td>
<td>35</td>
<td>45</td>
<td>0</td>
</tr>
</tbody>
</table>

Our vision, a sustainable food future
Area equivalent

Off farm | Crop residue | Planted Fodder

Bracharia 2:1 Ratio

Dairy Meal

Calliandra

Our vision, a sustainable food future
Area per dairy cow and per produced milk

Area for fodder production

Baseline | High Milk | Bracharia | 2:1 Ratio | Dairy meal | Calliandra

KAKAMEGA NEAR | KAKAMEGA REMOTE | BUNGOMA NEAR | BUNGOMA REMOTE | BUSIA NEAR | BUSIA REMOTE | SIAYA NEAR | SIAYA REMOTE

Area / milk

Baseline | High Milk | Bracharia | 2:1 Ratio | Dairy meal | Calliandra

Our vision, a sustainable food future
N Balance and GHG emissions

N balance

Kg N/yr/Milk

Baseline  Milk High  Bracharia  2:1 Ratio  Dairy meal  Calliandra

GHG emissions

Kg CO2eq/yr/Milk

Baseline  Milk High  Bracharia  2:1 Ratio  Dairy meal  Calliandra

Our vision, a sustainable food future
Does it make economic sense?

**Total value of production (KSH/yr)**

- **KAKAMEGA NEAR**
- **KAKAMEGA REMOTE**
- **BUNGOMA NEAR**
- **BUNGOMA REMOTE**
- **BUSIA NEAR**
- **BUSIA REMOTE**
- **SIAYA NEAR**
- **SIAYA REMOTE**

- **Current Baseline**
- **High Milk**

**KSH**

- 0
- 2000
- 4000
- 6000
- 8000
- 10000
- 12000
- 14000
- 16000
- 18000
- 20000
- 22000
- 24000
- 26000
- 28000
- 30000

**DM/MOLAS SE**

**DEWORM**

**VACC**

**TICK**

**AI**

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Example for Kakamega Near

Payback Period:
Number of years necessary to pay back the initial investment

- Milk High: Establishment year
- Bracharia: Establishment year
- 2:1 Ratio: Establishment year
- Dairy Meal: 2nd year
- Calliandra: Establishment year

NPV

<table>
<thead>
<tr>
<th>Plant</th>
<th>Establishment Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk High</td>
<td></td>
</tr>
<tr>
<td>Bracharia</td>
<td></td>
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<td>Calliandra</td>
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Our vision, a sustainable food future
Environmental sustainability

N balance

GHG emissions

Our vision, a sustainable food future
FGD: farmers’ opinions

1) Cost of establishment?
2) Positive/negative aspects, challenges?
3) Is it realistic? Would you do it? Why?
4) How much land for food and for fodder?

Our vision, a sustainable food future
Conclusion and outlook

• Potential for 3000 L/year

• Economically feasible

• Labour intensive, labour force is limiting

• Development of CLEANED tool