Potential multi-dimensional impacts of improved livestock feeding options

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Background

- Two-thirds of smallholder farmers in eastern and central Africa rely on mixed crop-livestock systems, and increasing demographic pressures and climate variability put livelihoods at risk[1]
- East Africa (EA) has one of the highest greenhouse gas (GHG) emissions intensities and lowest feed use efficiencies worldwide[1]
- Improved livestock feeding and forages can contribute to increased livestock productivity while potentially mitigating and adapting to climate change, which provides an opportunity for sustainable intensification of crop-livestock systems[1]
- Multi-dimensional analysis with other dimensions of farm performance necessary[2]

Figure 1. Livestock feeding on maize stover, communal grassland and crop residues

Materials and Methods

- A household survey (N=90) was used to derive a livestock and feed based typology in Babati district, Northern Tanzania using principal component analysis and hierarchal cluster analysis
- Survey and typology data were used to model representative farms in the bio-economic static model FarmDESIGN[3] and two improved feeding scenarios were developed for farms from three different types
- Scenario 1: improving quality of feed by increasing the amount of concentrates fed to livestock
- Scenario 2: increasing the amount of concentrates fed to livestock and feeding intercropped Napier grass and Desmodium (10-33% of crop area)
- Modeling of farm-level GHG emissions based on IPCC Tier 1 and 2

Results

Table 1. Mean characteristics of feed based farm types in Babati district, Tanzania identified by cluster analysis.

	Small farm with medium livestock herd and high inputs	Small farm with small livestock herd (SL)	Small farm specialized in small ruminants (SR)	Intermediate farm with large livestock herd (IL)	Intermediate farm specialized in dairy	Large farm with large livestock herd
% of farms	4	38	9	41	4	5
Area (ha)	1.0	1.0	1.6	2.1	2.7	7.8
TLU	5.0	2.7	10.1	4.4	5.7	13.8
Improved cattle (nb)	0.0	0.2	0.0	0.2	2.7	0.5
Small ruminants (nb)	7.3	4.8	26.6	6.2	12.3	20.3
Grazing time (h/d)	10.3	6.2	9.7	8.6	9.0	7.5
Supplement (kg/TLU/y)	116.9	16.2	0.7	2.8	15.2	1.8

Results

Six types of smallholder farmers were identified for Babati district, however 88% of all farms are represented by three types only: small farms with small livestock herd (SL, n=30), small farms specialized in small ruminants (SR, n=7) and intermediate farms with higher livestock (IL, n=33; Table 1)

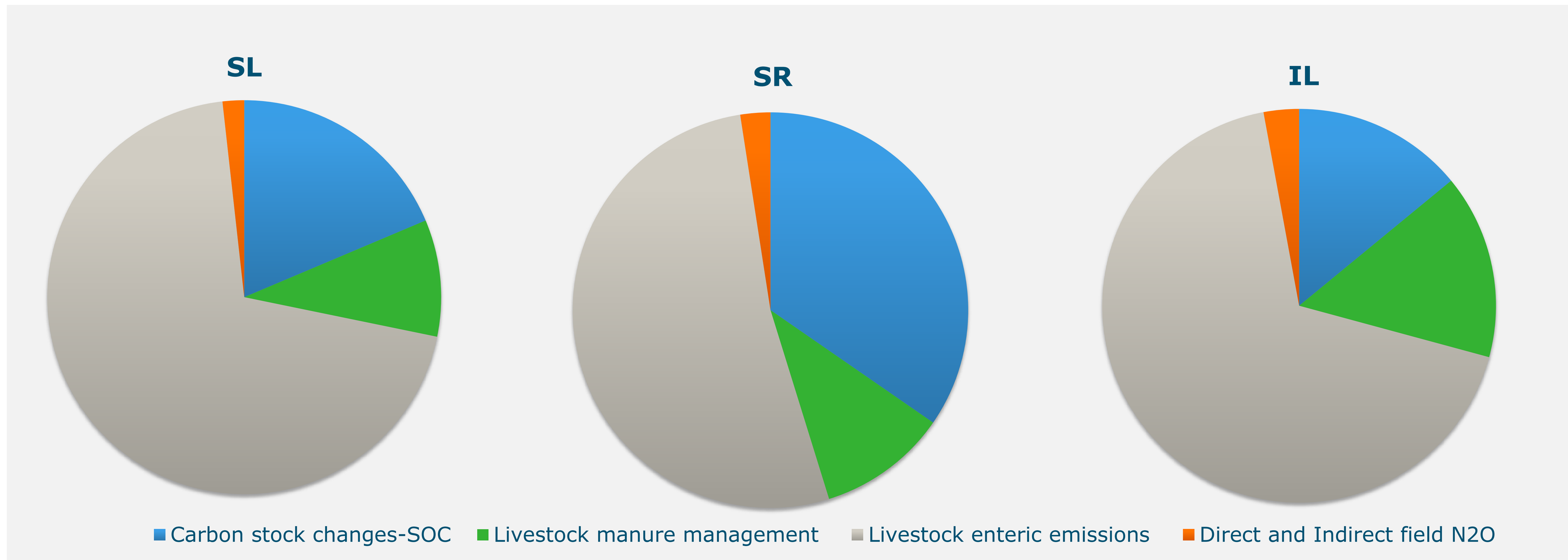

Figure 2. Sources of GHG emissions of baseline farms (% of total GHG emissions in Mg CO_2-eq)

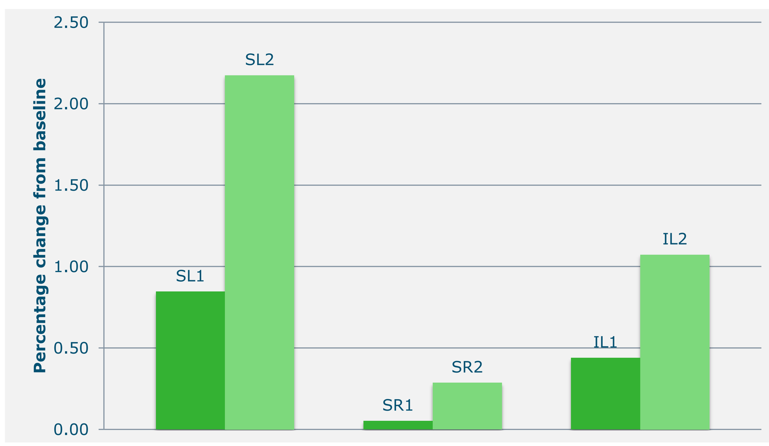

Figure 3. Change in organic matter balance (% of organic matter in kg/ha)

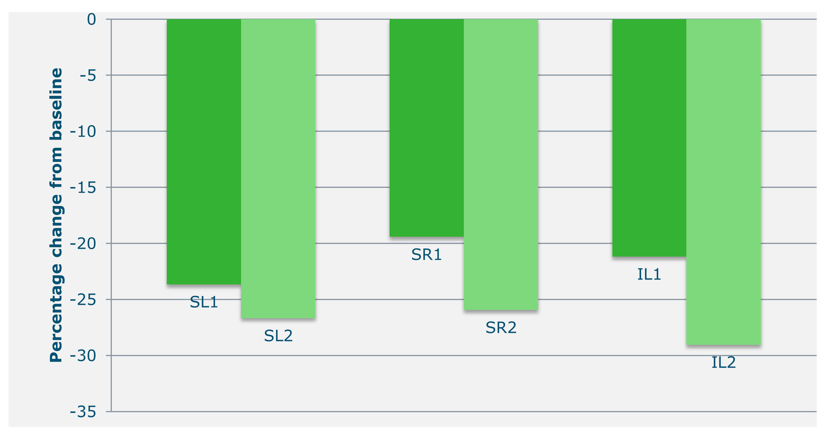

Figure 4. Change in GHG intensity (% change of GHG in kg CO_2-eq/kg FPCM)

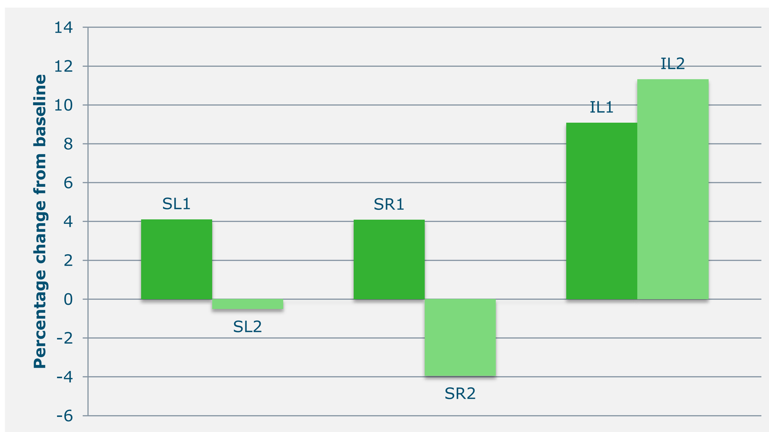

Figure 5. Change in operating profit (% change of operating profit in TSh)

Figure 6. Cut and carry feeding system

Discussion and conclusions

- Livestock is the largest contributor of GHG in smallholder farms, especially enteric fermentation from cattle
- Improved livestock feeding options improve SOM balance and decrease GHG intensity per farm, especially when improved forages are integrated
- Improved forages result in higher operating profits on intermediate farm sizes, but decrease profits on small farms where the opportunity costs of land is too high
- The modeling approach will be extended with IPCC Tier 2 and 3 methods such as the Ruminant model for milk production and enteric fermentation
- Other intensification options - including improved livestock breeds, high yielding forage and crop varieties, and mineral fertilizer application - need to be modeled to assist in prioritization of technologies

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