# Rapid ex-ante environmental impact assessment of livestock intensification strategies on mixed crop-livestock and agro-pastoralist farmers in Tanga region, Tanzania

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## Background

- Livestock production supports around 600 Mio. smallholders in the developing world
- Environmental impacts include water pollution, global warming, soil degradation, water use and pollution, and biodiversity loss
- Long-term sustainability needs to be assessed before designing large-scale livestock development projects, but data is sparse and quick results needed
- Therefore, a quick ex-ante environmental impact assessment tool was developed, focusing on soil nutrient balances and greenhouse gas emissions[1]

**Figure 1.** Manure heap in mixed crop-livestock system (left); agro-pastoralist family (middle); zero-grazing unit in mixed crop-livestock farm (all pictures Jessica Koge, CIAT)

## Materials and Methods

- A participatory GIS exercise[2] in June 2014 in Lushoto, Tanga region, Tanzania, resulted in two types of farming systems: intensive mixed crop-livestock systems and extensive agro-pastoral systems (Figure 1 and 2)
- Representative farms of both types were visited and interviewed in May 2015 in Lushoto (mixed crop-livestock) and Handeni (agro-pastoral). Data was complemented with a previously conducted feed assessment in the area[3]. Data described agro-ecology, crops, land use, inputs, livestock herd, manure, and livestock feeding
- Intervention scenarios were based on village development plans from both sites: improved breeds, improved feeding, and increased animal health
- Modeling of farm-level GHG emissions was based on IPCC tier 2 guidelines[4]
- Nutrient balances were calculated using the NUTMON method[5]

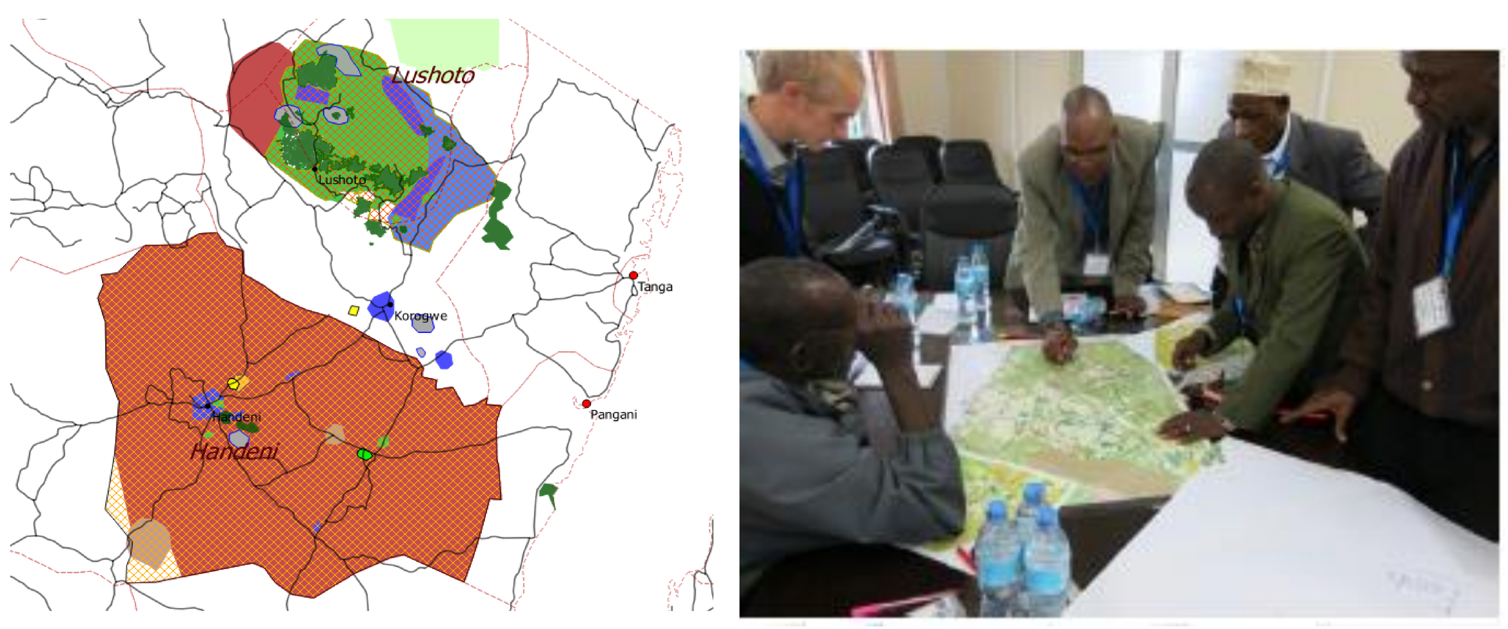


**Figure 2.** Farming systems in Lushoto and Handeni as mapped by the participants of a participatory GIS workshop (from Morris et al. 2014)

## Results

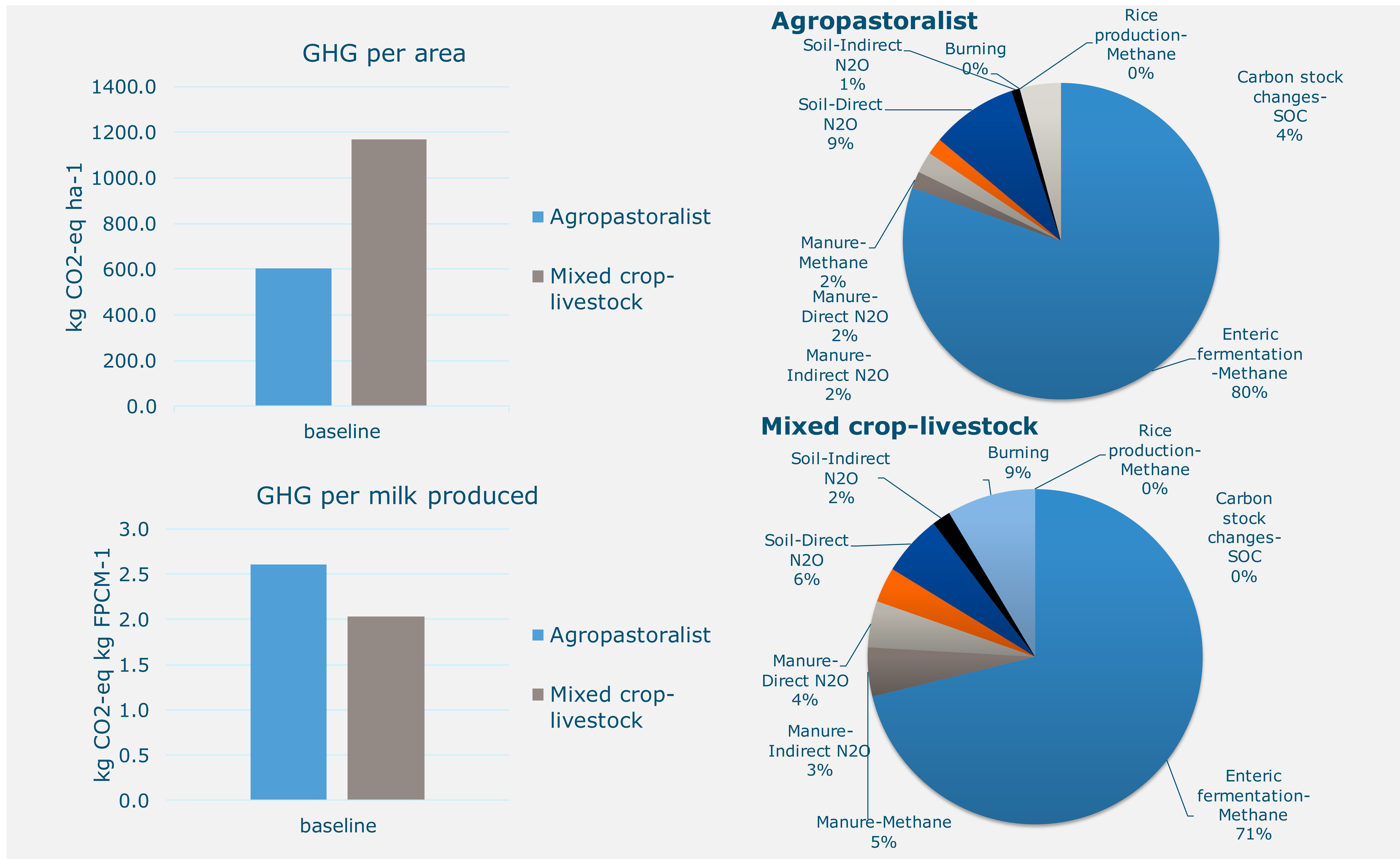


**Figure 3.** Baseline GHG per farm type in per area and milk basis (left); baseline sources of GHG emissions in % for the different farm types (right)

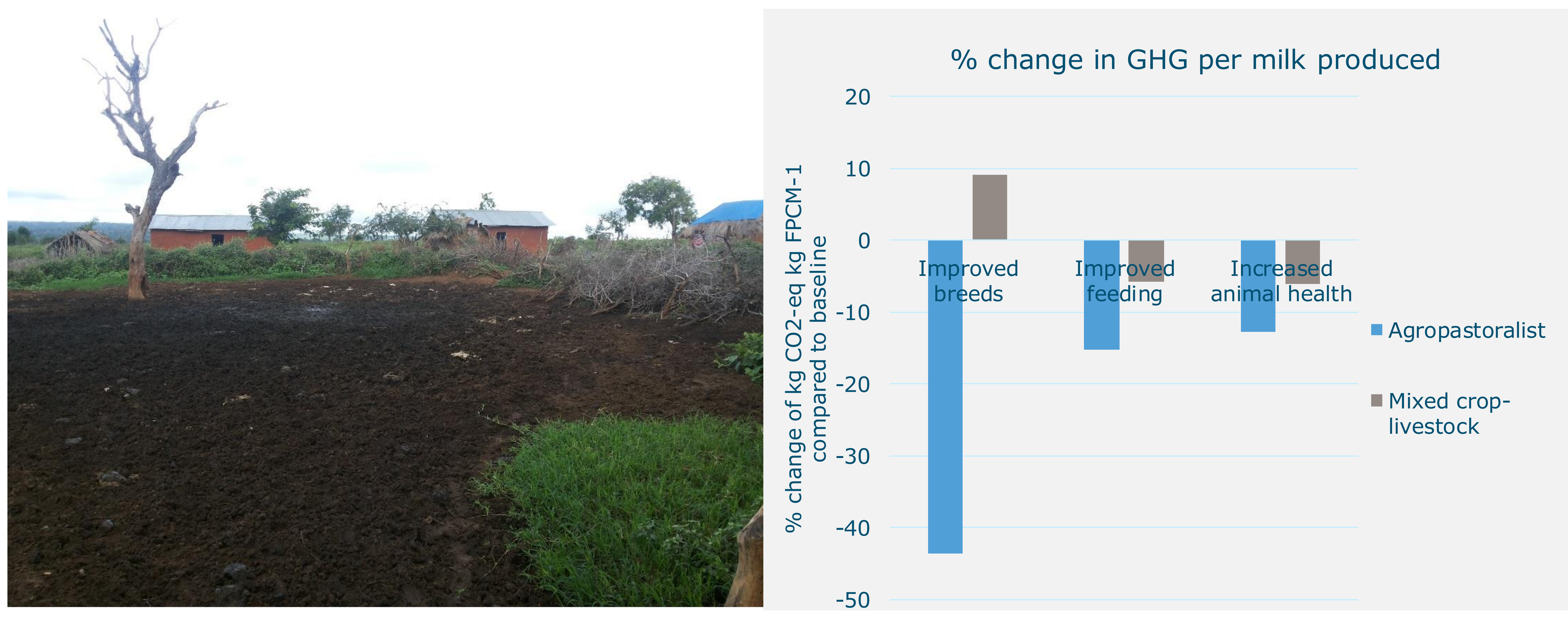


**Figure 4.** Livestock kraal in agropastoral system (left); changes in GHG emission intensity Nutrient balances of baseline and scenarios (right)

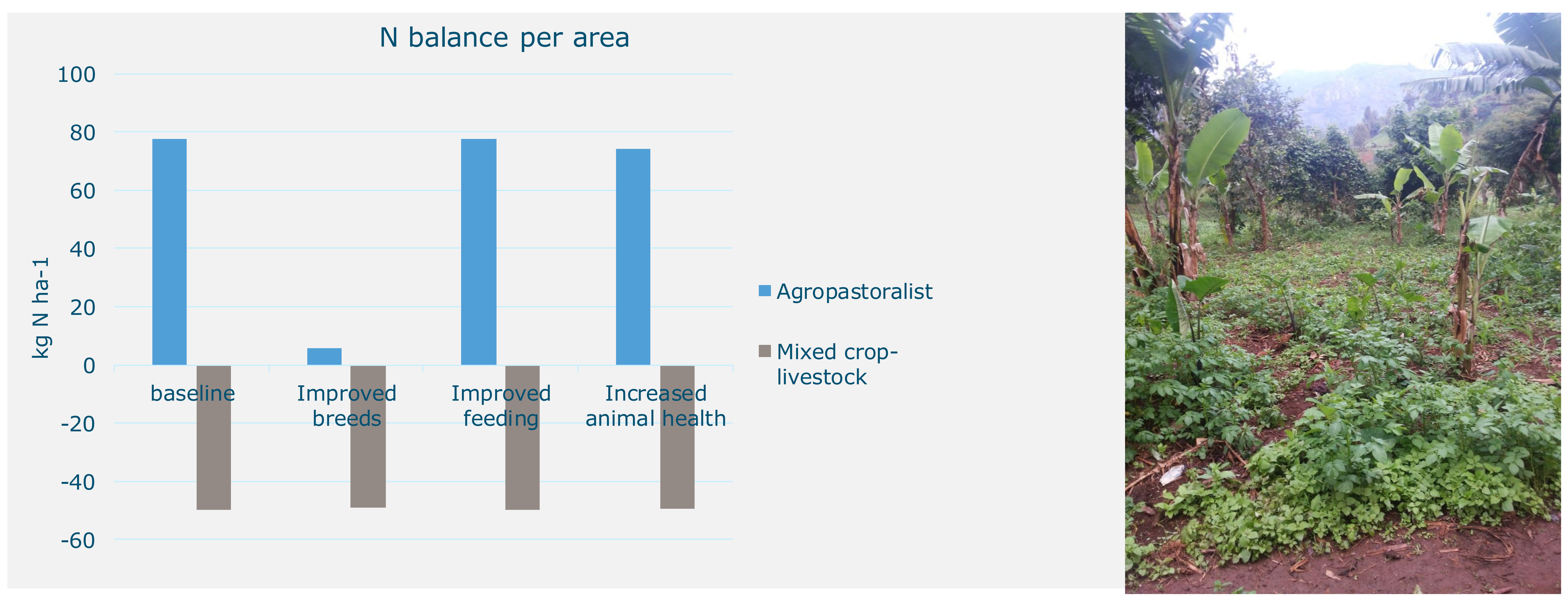


**Figure 5.** Nitrogen balances for baseline and scenarios (left); cropping system diversity in mixed crop-livestock system (right)

## Results and discussion

- 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
- Further work: outscaling to regional level, flagging risks into low/medium/high, feeding results into regional/national dairy platforms

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**References**

1. Notenbaert, A., Lannerstad, M., Herrero, M., Paul, B., Fraval, S., Ran, Y., Mugatha, S., Barron, J. (2014). A framework for environmental ex-ante impact assessment of livestock value chains. All African Animal Agriculture Conference Paper.
2. Morris, J., Fraval, S., Githoro, E., Mugatha, S., Ran, Y. (2014). Participatory GIS expert workshop report in Lushoto. SEI, ILRI.
3. Mangesho, W., Loina, R., Bwire, J., Maass, B.L., Lukuyu, B. (2013). Report of Feeding System Assessment (FEAST) in Lushoto. TALIRI, CIAT, ILRI.
4. International Panel for Climate Change (IPCC) (2006). IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (Eds).
5. Vlaming, J., van den Bosch, H., van Wijk, M.S., de Jager, A., Bannink, A., van Keulen, H. (2001). Monitoring nutrient flows and economic performance in tropical farming systems. Annex. Alterra, the Netherlands.